# The Dock and Harbour Authority

No. 203. Vol. XVII. Edited by BRYSSON CUNNINGHAM, D.Sc., B.E., F.R.S.E., M.Inst.C.E. SEPTEMBER, 1937

## *Editorial Comments*

### An Atlantic Island Harbour.

The Island of Madeira, out in the Atlantic midway between England and the Equator, has long been justly celebrated for its wonderfully equable climate, and not less for its wines, though the latter, perhaps, in modern times have gone a little out of fashion and been supplanted to some extent by the lighter produce of French and German vineyards. Lovers of Dickens will recall from the "Pickwick Papers" how Sam Weller, summoned by his master on leaving Mrs. Leo Hunter's Fête Champêtre, or public breakfast, "emerged from a sequestered spot, where he had been engaged in discussing a bottle of Madeira, which he had abstracted from the breakfast table, an hour or two before." Allusions to glasses of Madeira, with or without the customary accompaniment of seed cake, are common enough in the literature of last century. There are signs, however, of reviving popularity, and Madeira wine, "strong-bodied and of fine bouquet," which we have had the agreeable opportunity of sampling at the source of supply, forms one of the leading exports of the island.

Romance is associated with the first historical mention of the island. The discovery of Madeira is said to date back to the year 1344 or 1346, when according to legend, a certain Robert Machin and his betrothed wife, Anna d'Arfet, fleeing from parental opposition in England to France, were driven out of their course by a violent storm and cast ashore at a place subsequently named Machico in memory of one of them. In all probability, the island had been visited long before that date by Genoese navigational adventurers.

Funchal, the only port of entry, lies in an open bay on the South Coast. Its curving shore, backed by a range of lofty mountains, intersected by ravines and terraced with gardens and vineyards, presents a charming panorama of colour and cheerfulness. The town is quaint and attractive, its streets paved with small rounded smooth cobble stones, over which slide with facility the wooden sledges, or "carros," drawn by bullocks, which are used for transport and conveyance.

So much for the local setting of the place. The harbour works, described in the present issue by Senhor Coutinho de Lima, the engineer in charge, are yet in an early stage of development, but they possess a number of interesting features, which attracted our notice while inspecting the breakwater and its appurtenances.

Through the courtesy of Senhor de Lima, and the contractors, Messrs. Hojgaard and Schultz, of Copenhagen, we visited also the installation on a neighbouring beach where gravel, shingle and sand are obtained and graded by machinery for use in the manufacture of concrete for the great caisson blocks which form the principal constructional element in the breakwaters. The local stone is basalt, volcanic in origin, yielding, when quarried, an ample proportion of small fragments, but owing to the lack of local sand, inconvenient for use as material for making concrete. The beach shingle and gravel afford a more suitable body of ingredients for the purpose.

When the arm of the breakwater at present in hand is completed, Funchal will have a serviceable degree of protection from the south and south-west, whence, occasionally, winds drive heavy seas into the bay. Also, with the projection of the present passenger jetty to meet the outer extremity of the completed breakwater, there will be formed an enclosure which will provide ample accommodation and shelter for the shipping needs of the port.

### Port Marghera, Venice.

One is so accustomed to associate Venice with mediæval art and history, in which romance plays a not inconsiderable part, that it comes almost as a shock to realise that the ancient city, home of painting, poetry and music, and centre of Italian culture, is winning a leading place, or should we say, re-asserting her former prominence as a mercantile port? Yet, as will be evident from the detailed statement broadcast recently from Rome, which is translated and reproduced on page 314 of this issue, there is vigorous development in progress at the industrial Port of Marghera, which is rising on the mainland adjacent to the Venetian lagoon and is destined to provide the necessary area of expansion for shipping and commerce, which cannot be forthcoming within the narrow limits of the ancient city. Several years have elapsed since we last visited the port, and, even then, we were struck by the enterprising activity which was evident on all sides. The nearest parallel to Port Marghera in this country is Manchester, with its warehousing and industrial adjunct of Trafford Park. There can be little doubt that the close proximity of manufacturing districts to port areas is beneficial to both, and in Port Marghera, Professor Coen Cagli has exemplified what can be done in the way of scientific arrangement and organisation for the joint concerns.

### The Dartford-Purfleet Tunnel.

After protracted negotiation, the Amended Bill for the construction of a tunnel beneath the Thames between Purfleet and Dartford, originally authorised by Statute in 1930, has become law. Variations of design have been included in the new measure. No provision is now made for pedestrian traffic, footways being replaced by passageways for patrols. The internal diameter of the tunnel has, in consequence, been reduced from 34-ft. to 30-ft. 6-in., though the carriageway is a foot wider than before, being 20-ft. instead of 19-ft. The estimated cost of the undertaking, which is actually well in hand, is £3,500,000.

A point of important, and even anxious, consideration by the authorities concerned in the matter, has been the level of the crown of the tunnel in relation to the dredged level of the river bed, not merely at the present time, but after making provision for probable and possible developments in the draught of vessels using the port. The tunnel will form a permanent threshold or sill, over which all ships of the most distant future will have to pass, and, once constructed, it will be as inexorable as the bed of Procrustes. It is, therefore, obvious that the work must be carried out at a sufficiently low level to admit of adequate channel deepening operations, as and when these become necessary. On the other hand, any excessive and unnecessary depth given to the tunnel would entail increased constructional cost in a rising ratio, and would diminish the convenience and facility of the structure for traffic.

After the fullest investigation, the Port of London Authority have specified an allowance of 50-ft. in depth below Admiralty Chart Datum (low water level). Actually, it is understood that the minimum depth of the crown of the tunnel will be 55-ft. below Admiralty Chart Datum. The present authorised level for the dredged channel over the site of the tunnel as far as Coldharbour Point is 30-ft. below low water spring tides. A margin of 20-ft. should afford ample scope for developments in the future, so far as they can be forecast as likely and practicable within the limits of prevailing conditions.

## *Editorial Comments—continued*

### Port of London Charges.

The dominant topic of the Report for the year 1936-7 of the Committee of the London General Shipowners' Society, which was presented at the annual general meeting of members on July 23rd, was undoubtedly the representations of the Society to the Port of London Authority in regard to the charges of the latter for services and accommodation in the port. The matters at issue, six in number, occupy so prominent and extensive a place in the report that they merit some notice, although it is not practicable to refer to them all in detail, at any rate in this issue. Summarised, the complaints refer to alleged excessive charges for dry docking vessels and for overtime in the case of vessels loading; to insufficient allowance for the cost of passing cargo over quay, with similar complaints of excess in regard to river tonnage dues and for dock dues on vessels discharging part cargoes. These grievances, extending over a period of years, have been the subject of a recent conference with the Authority and their officials, whose reply in most cases has been that while the excess or incidence of the charges could hardly be justified on strictly logical grounds, yet the redress of the grievances by the reduction of rates and charges would involve the Authority in a loss of revenue which the state of their finances would not permit them to incur.

Taking the case of dry docking charges, which, it is claimed, are unduly high in comparison with those at some of the outports, the Authority are stated to have contested the claim for reduction on the ground, partly, that the dry docks of the port do not " pay their way." This, of course, is scarcely a satisfactory answer from the shipowners' point of view. If, they naturally ask, it is possible to charge less at other ports in the country, why should not the London charges be reduced? On the other hand, it has to be admitted that, however necessary graving docks may be as operative adjuncts, they are expensive port appendages on which the capital outlay is often considerable, especially where, as in the case of London, docks of large size have to be provided for the possible use of vessels of great calibre. The return on capital expended on dry dock construction is generally very meagre, and it not infrequently happens that the owner of a private graving dock makes his profit not on the hire of the dock, but on the works which he, as a ship-repairer, contracts to execute while the ship is in the dock. This is not possible in the case of the Port Authority, who are not ship-repairing contractors. At the same time, it is but fair to add that the application of this argument to the case in point is not admitted by the Shipowners' Society.

Perhaps the root trouble of the major part of the complaints may be found to lie in the illogicality in certain cases of rate application. Double river tonnage dues are imposed by the Authority under Section 45 of the Port of London Act, 1920, upon a vessel in the foreign-going trade arriving in London with a part cargo for a Continental (home trade) port, which, without discharging in London, loads there additional cargo for that port. The Society have pointed out that, if such a vessel arrived with a part cargo and sailed without breaking bulk and without loading further cargo, she would pay no dues at all, while if she arrived in ballast and loaded outwards she would pay outward dues only. The inconsistency of this discrimination is admitted by the Port Authority, but again they say that a revision of the rates to remedy the anomaly would be financially prohibitive.

Similarly, in the case of the hire of shed or quay space from the Authority, the compulsory passage of inward cargo over the quay at a fixed unremunerative rate involves shipowners, who act as agents for the Port Authority, in a heavy loss and they feel that under their contract of carriage with the merchant they are entitled to restrict their obligations to the delivery of cargo at the ship's side without liability for any expense beyond that point. Financial considerations again prevent the raising by the Authority of the rate payable to the shipowners.

In all these cases any alteration of existing rates and charges is hampered by the extraneous, but none the less fundamental, necessity of maintaining the port revenues. The Port of London is not a profit-making concern: it distributes no dividends to shareholders, but none the less it has " to pay its way " and meet interest charges on its stocks. Whether it is possible by adjustment to place certain of the anomalous charges on a more rational and equitable basis is a problem which may well receive the attention of the Port Authority. There is an inveterate dislike on the part of the Englishman to being unfairly treated. He does not grumble so much at high charges, provided they are justifiable, as at charges which exhibit partiality or discrimination. From force of circumstances, London can hardly claim to be a cheap port, but it is an efficient port and its administration is, no doubt, having regard to the local conditions, as economical as can be devised. From an unbiased standpoint there will be sympathy with the case presented by the Shipowners' Society in their Report and it may happen that, with the increasing prosperity of the country, means will be found to rectify the more conspicuous anomalies to which they have called attention.

### The St. Lawrence Ship Channel.

A significant admission respecting the relative efficiency and economy of dredging operations by departmental administration and by contractural service is contained in a recent statement issued by Mr. C. D. Howe, the Canadian Minister of Transport, on the present position of the deepening work on the St. Lawrence Channel from the Port of Montreal to the sea, which it is proposed should have a navigable depth throughout of 35-ft.

Hitherto, states Mr. Howe, the development has been carried on partly by contract and partly by departmental administration. The unit cost of contract work proves to be considerably lower than the cost of similar work executed by the Department's own dredging fleet, which consists at the present time of 12 dredgers, six tugs and some 35 units, comprising hopper barges, dump scows, coal barges and similar equipment, a considerable proportion of which, however, is reported to be obsolete and unfit for further use.

The Department have maintained a shipyard at Sorel for the purpose of overhauling and executing repairs to the fleet. This shipyard has been a constant source of trouble on account of administrative difficulties. The number of men employed has ranged from 300 to over a thousand, and the services performed by the yard have been, it is affirmed, a poor return on the cost of the installation.

It is scarcely surprising, under these circumstances, that the Minister, advised by his own chief officers, should have decided on a change of policy. Arrangements are being made to dispose of the shipyard and the dredging fleet, concurrently with the acceptance of a tender for the completion of the work by contract.

The decision cannot be flattering to local departmental prestige, and exculpatory reasons will no doubt be forthcoming for the unfortunate situation on Canada's leading waterway. But facts are stubborn things, and the Minister, with a proper regard for the economical expenditure of public money, is undoubtedly right in abandoning any further efforts to maintain a service which has failed to justify its existence. It does not follow, of course, that all departmental administration in river and port matters falls under the same condemnation, but the experience indicates the necessity of close supervision and scrutiny in order to prevent extravagant expenditure.

### Liverpool as a Fishing Port.

The idea of making Liverpool a great centre of the fishing industry has recently been engaging the attention of certain Liverpool shipowners and influential local gentlemen, who have approached the Town Council with a view to securing from the latter some financial support for a scheme for the acquisition of a fleet of trawlers, by guaranteeing the interest on a loan, on the ground that, if the project was successfully launched, it would relieve local unemployment by providing work not only in the fishing industry itself, but in such allied activities as ice manufacture, box-making, fish meal manufacture, fish curing, sail making and repairing, etc.

The Corporation, as advised by Mr. W. H. Baines, their Town Clerk, in a report on the matter submitted to the Employment (Special) Committee, have been unable to entertain the proposal for financial assistance in any shape or form, but they have indicated their moral support of the undertaking, if it were launched by private enterprise.

Apparently, however, money or credit is the more urgent necessity, and the promoters have approached the Ministry of Labour, who in consultation with the Ministry of Agriculture and Fisheries, have felt themselves obliged to reject the application, and stated that they did so for the following among other reasons:

1. The difficulties which are at present being experienced by West Coast fishing ports, were likely to be accentuated by an additional fleet operating from Liverpool over the same fishing grounds.

2. That it was unlikely that the establishment of Liverpool as a competitive fishing port would add to the total volume of employment in the fishing industry.

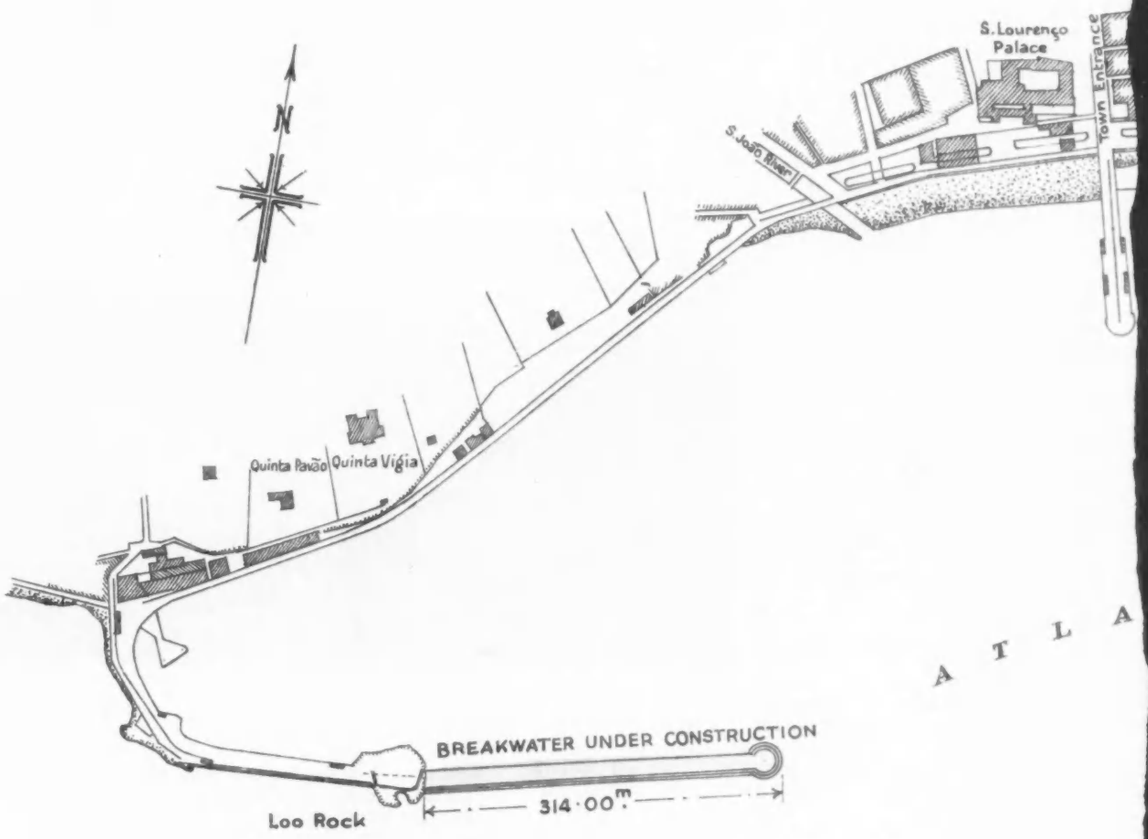
3. That anything in the nature of a Government guarantee or other Government financial assistance for the establishment of a competitive port at Liverpool would give rise to great resentment among the rest of the British fishing industry.

With these arguments, there will be a general disposition on the part of disinterested persons to concur, and however much one may admire the optimism of the promoters of the scheme, it is impossible not to have misgivings as to the effect of their proposal, if it matured. The trawling industry at the present time is faced with a serious situation, due to over-production and the rising costs of operation. So insistent is the problem that the British Trawlers' Association have recently held a National Conference, which was attended by the representatives of a number of interested ports, when a proposal was put forward for the laying-up of a certain percentage of tonnage or a reduction of fishing time. Such a proposition augurs ill for the success of a new venture of the kind contemplated at Liverpool.

# PORT OF FUNCHAL.

## (MADEIRA)

*Snr. JOÃO RIBEIRO COUTINHO DE LIMA, ENGINEERING DIRECTOR OF THE HARBOUR*

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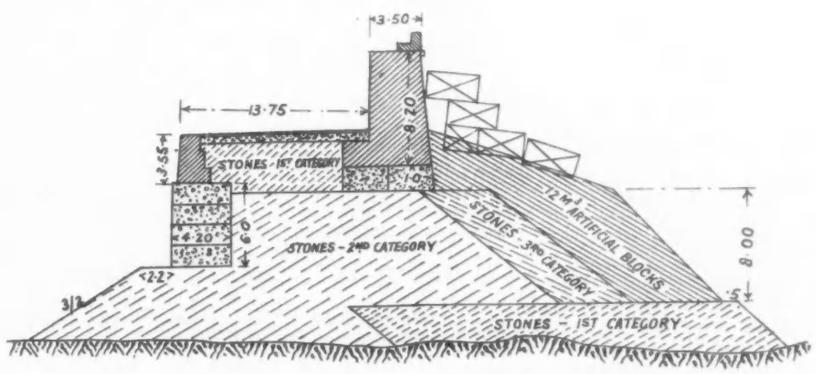


FIG. 1 – NORMAL SECTION OF FIRST BREAKWATER (1890)

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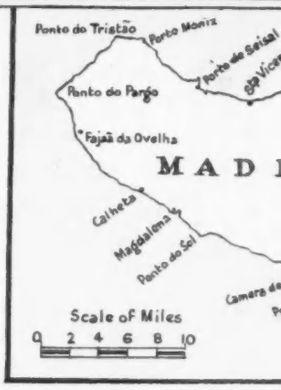
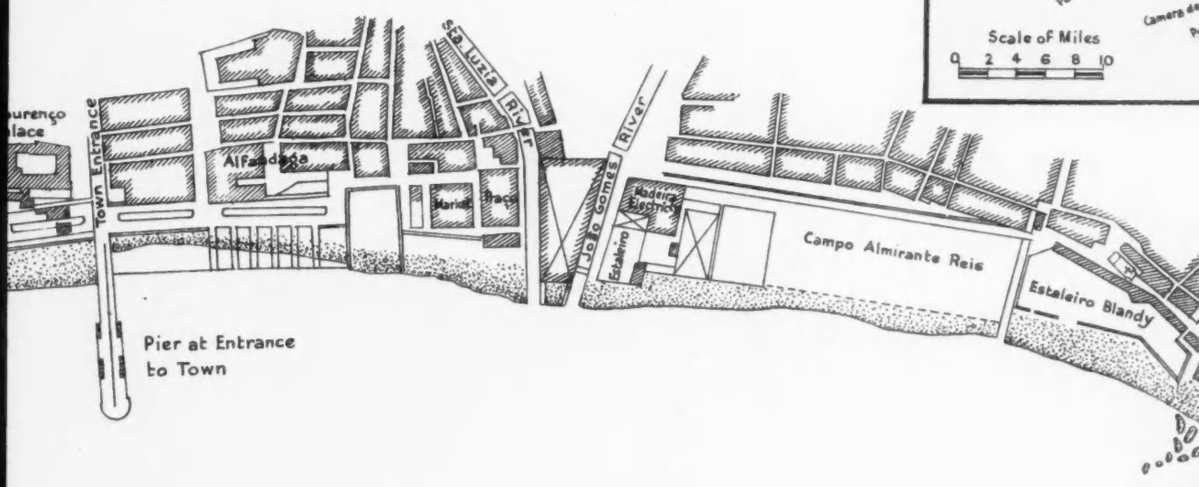
RBOUR WORKS.




LANTIC OCEAN

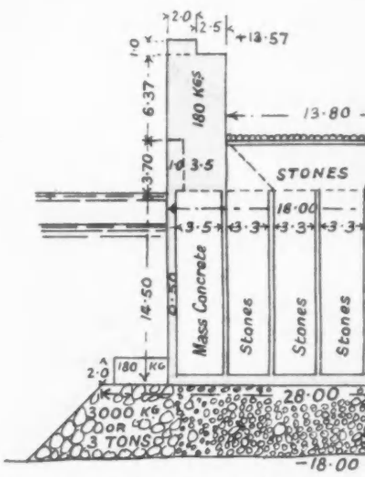



FIG. 2 — ORIGINAL SECTIO

Scale for Plan.

0 200 300 400 500 Metres

Scale for Sections.

10 20 30 Metres

1 Metre = 3·28 Feet

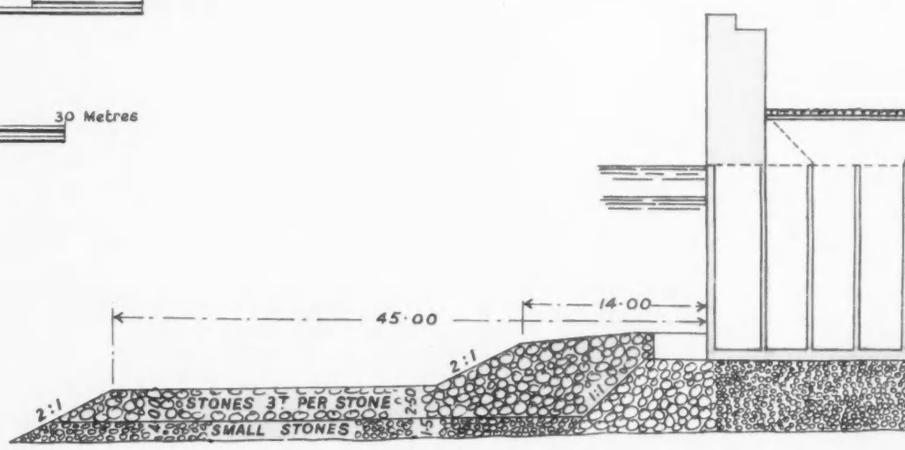
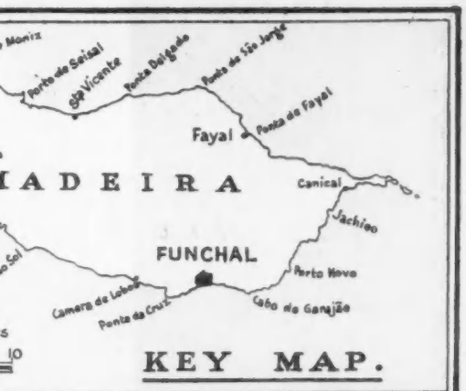
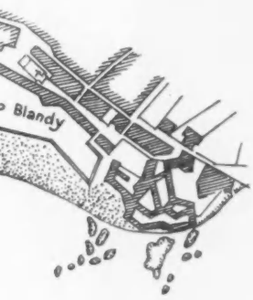



FIG. 3 — MODIFIED SECTION OF BREA

WARD & FOXLOW, LITH., HARCOURT STREET, MARYLEBONE, W.




KEY MAP.

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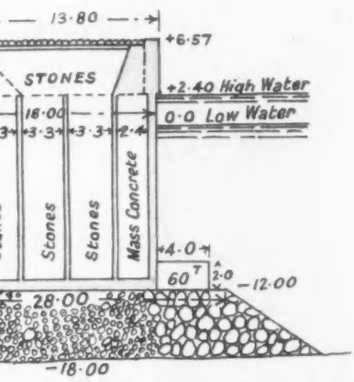
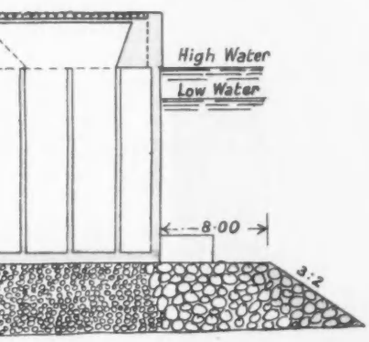



SECTION OF BREAKWATER.




OF BREAKWATER.

# The Port of Funchal, Madeira

*By JOAO RIBEIRO COUTINHO DE LIMA, Engineering Director of the Port.*

## Situation.

THE Port of Funchal takes advantage of a bay situated on the South Coast of the Island of Madeira. It has a natural anchorage of great depth, sheltered from the prevailing winds, from W. to E.S.E., by the massive mountains of the island. It is only unprotected from the S.E. to the W.S.W. on the South. In this quadrant winds sometimes blow which attain their highest frequency and greatest intensity from the S.S.W. On most days of the year the Bay of Funchal is calm and it is only occasionally that steamers are compelled to seek safety in a port at the North of the Island. The storms that are felt in the Bay of Funchal from the South quadrant are of short duration and allow ships, providing they can wait, to complete their working.

For these reasons and owing to the position of the Island of Madeira in the Atlantic, the Bay of Funchal is very much frequented by passenger steamers, either tourist or regular lines. In the year 1936, 1,390 steamers entered Funchal bringing 170,815 passengers.

*The Passenger Pier.*

## Completed Works.

Being aware of the necessity of establishing a shelter for local cargo boats and small steamers, a breakwater was built in 1890 on a stone base, finished off with concrete blocks as shown in Fig. 1 (in the supplement) projecting between the mainland and the Loo Rock.

Only part of the commercial movement of the port is carried on within the area sheltered by this breakwater which is used only for ships of small tonnage; also, part of the coal, which is supplied to steamers, is stored here. Other merchandise, which is brought by ships of greater tonnage, is discharged by lighters and boats which are hauled up on the beach.

The breakwater is a structure which is manifestly insufficient for the object in view, but from 1890 to 1931 no other was built.

Although the Port of Funchal is administered by a self-governing Board who are in charge of all the necessary works of construction and the respective exploitation of same, it was a committee of expert engineers who, in 1928, decided on the works which should be undertaken in the port, in accordance with the character of the hinterland and with the economic and touristic possibilities of the Island.

The works decided upon by that committee of engineers are the following:—

(a) Lengthening the pier in front of the town;

(b) Establishing a railway for the construction of the breakwater;

(c) Construction of a breakwater about 300 metres in length;

(d) Construction of a sea front promenade for the benefit of tourists.

(e) Construction of discharging wharfs for regional merchandise.

Of these works, the pier in front of the town has already been completed and the breakwater, 314 metres in length, is in course of construction.

The following is a description of each of these works:—

## Passenger Pier.

A great number of the steamers that call at the Port of Funchal only stay in port a few hours and for this reason they do not require a quay berth, but as they carry in transit a great number of passengers, a pier, that would permit of the easy disembarkation of the passengers, was indispensable.

A good service of launches transport the passengers, who want to visit the Island, from the steamer anchored in the bay to this pier.

Already in 1890, a small pier had been built, containing two flights of steps, but its short length, together with the gradual accretion of the beach, caused these steps to become almost useless.

For this reason the pier was lengthened by 80 metres so as to accommodate four flights of steps, and it has a circular head which serves as an esplanade.

The structure was formed of a series of cellular blocks of reinforced concrete placed on a prepared bottom, with sacks of concrete. The lack of space for slipways, the rocky nature of the bottom, which forms a solid foundation, and the insignificance of the waves in the bay makes this system of construction advisable.

The concrete blocks were built on a slipway near a quarry about 2 miles distant from Funchal. The inclined plane for launching the blocks, which was laid according to the slope of the beach, had a fall of 1/5, and the space in which to build the blocks was very limited.

It was, therefore, necessary to adopt an appropriate arrangement which consisted in building the blocks, half on a platform upon the top end of the inclined plane and the other half on wooden stays fixed to the inclined plane.

When a block was finished all that was necessary was to fill the back compartments with water, remove the stays and the water passing from the back compartments to the front ones caused the block to drop on to the inclined plane and slide into the sea and float.

Once afloat the blocks were towed to the position where they were to be placed. Upon these blocks, the exterior compartments having been filled up with concrete and the interior ones with stone, was built a solid mass of stone and mortar the facings being finished off with free-stone to a height of (+7.00).

To-day, the pier in front of the town with its four new flights of steps offers every convenience to passengers landing and embarking.

It was built by the firm "Nederlandsche Maatchappij Voor Havenwerken, N.V." by tender for the sum of Esc. 5.562.048 $28 (£50,000).

The work was started in 1931 and finished in 1933.

## Breakwater.

The greatest and most important work is the breakwater now under construction.

This work, the direction of which is almost perpendicular to a line S.S.W., is a great benefit to the port because it shelters a considerable area from these winds, which, in spite of being rare, are the most troublesome.

It is true that the port is exposed to the winds which blow from the S. and S.E., but these are very rare and their intensity is also greatly reduced by the "Desertas" Islands of the Archipelago, which are situated to the S.E. and form a natural shelter from them.

On the other hand the breakwater, being of the vertical type and the foundation being 12 metres below zero, will permit steamers, which frequent the port, to come alongside, also it has sufficient length to accommodate the cargo and passenger traffic from steamers whose stay in the port justifies their coming alongside.

For other steamers, only staying a short time in the port, the launch service from the pier at the entrance of the town is naturally indicated.

The official project was drawn up in 1930, and specified the construction of this breakwater for a length of 314 metres, to be built of concrete blocks in tiers one upon the other, each block weighing 262 tons. These blocks were to be made in large numbers in a yard and set in their destined positions by a crane.

The blocks were to have four rectangular compartments, which, when tiered in position would form another equal volume of large cavities to be filled with concrete. They were to be 18 metres long, 4 metres wide and 3.05 metres high; the length of each block to equal the width of the breakwater.

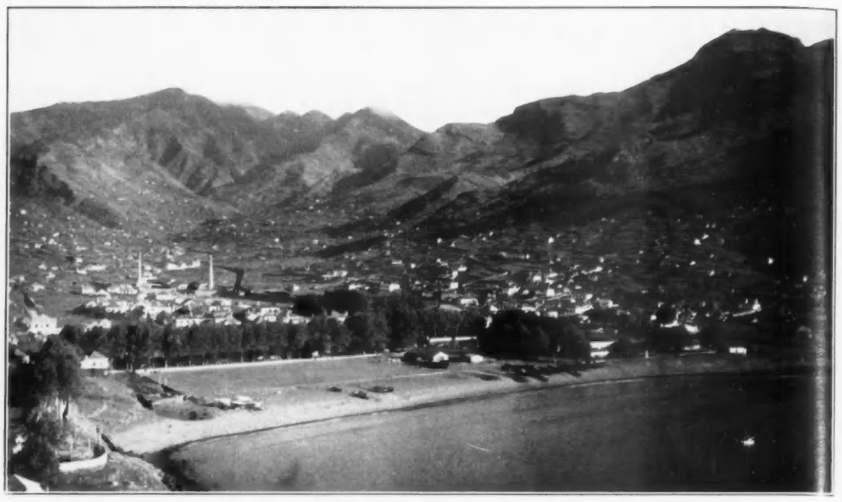
The blocks were to be laid upon a stone foundation levelled to a depth of (—12.00).

## *The Port of Funchal, Madeira—continued*

This foundation was to be 28 metres wide, of which 18 metres were for the actual width of the breakwater; 8 for two apron blocks of 60 tons each and 2 for outer ledges to protect these blocks. The slopes to be 1/1.

Many firms competed for the contract which was to be based upon this project for the amount of Esc. 34.000.000$00 (£310,000) and that of "The Sociedade de Empreitadas e Trabalhos Hidraulicos, Limitada," was accepted for the amount of Esc. 28,900,000$00 (£260,000).

This contracting firm, taking advantage of one of the provisions of the enactment, presented a proposal with an alteration which was accepted and which was as follows:—That the construction of the body of the breakwater instead of being made of blocks piled one upon the other would be made of cellular blocks of reinforced concrete which would be floated into their ultimate position. The stone foundation, the protective blocks and the shelter walls would be the same as in the original project.



*View of Machico, Madeira.*

This proposal was accepted and accordingly on the 9th of September, 1934, the construction of the breakwater was commenced according to the cross section in Fig. 2 (see Supplement).

In 1935, the International Congress of Navigation took place in Brussels and on the subject of breakwaters of the vertical type built on a bottom liable to be scoured by wave action, they advised establishing a covering on the bottom with a suitable protection for the guarding blocks.

On account of the conclusions of this Congress, and the investigations of MM. Gourret, Sainflou, Benezit and other engineers, it was thought that the breakwater of Funchal built on a layer of agglutinated sand, but liable to be excavated by the waves, which can attain a height of 9 metres, would not be able to stand up to the violence of a storm with the characteristics of one, such as that which devastated the South Coast of the Island of Madeira on the 15th of January, 1926. This was a storm with waves of 9 metres in height.

In fact, the breakwater of Funchal was being constructed as indicated in Fig. 2, with a foundation of stones up to 3,000 kilos each, to a depth of (—12.00); when according to that Congress the stone foundation should be levelled to a depth of (—13.50) and the width of the exterior platform should be about 12 metres and the guarding block should be connected with the body of the breakwater.

When the conclusions of the Congress became known, the stone foundation was already built and some blocks had been laid, so it was not possible to adopt those conclusions integrally.

On the initiative of the contracting firm, various experiments were made with models of the type of Fig. 2 and also several other arrangements for breakwater which were thought suitable. It was concluded that the type in Fig. 2, then under construction, did not present sufficient stability. The contracting firm, from the results obtained from the experiments with the models, presented a solution as shown in Fig. 3, with this difference, that the protection of the 45 metres in width and 4 metres in height would be built on an excavation on the bottom of the sea carried down in such a manner that the stone foundation did not project above the sea floor.

The Portuguese Government was of opinion that, on account of the sea bottom presenting a reasonable inclination and the body of the breakwater presenting a width of 18 metres, this was more than sufficient to protect the breakwater from scour. It is then the solution in Fig. 3 that is actually in course of execution. This protection of the sea bottom for a width of 45 metres together with a small reinforcement which is being made on the port side costs Esc. 4.000.000$00 (£36.000) more.

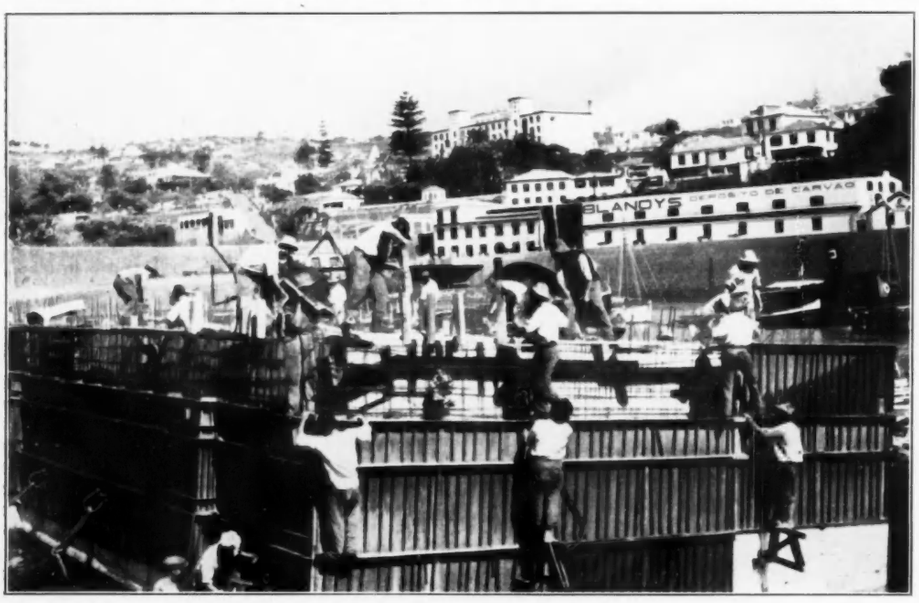
### Breakwater Features.

The construction of each of the parts of the breakwater is on the following lines:—

### (a) The Stone Mound Foundation.

The Island of Madeira is formed entirely of basalt of volcanic origin. The quarries that could be utilised for the supply of material for the works in execution would yield a great quantity of small fragments and it would be difficult to obtain stone with a weight of 3 tons for the exterior protection of the foundation. The exploitation of a quarry would be undoubtedly very expensive.

The contracting firm, in view of the geological formation of the Island, chose to extract the small stones for the nucleus of the stone foundation from a beach where stones of these small dimensions mixed with sand abound. The large stones for the exterior protection of the foundation are taken from the bottom of the sea with the aid of divers and a crane. In this way, the exploitation of a quarry is avoided and material is obtained, which having been exposed to wear by the action of the sea is very hard.



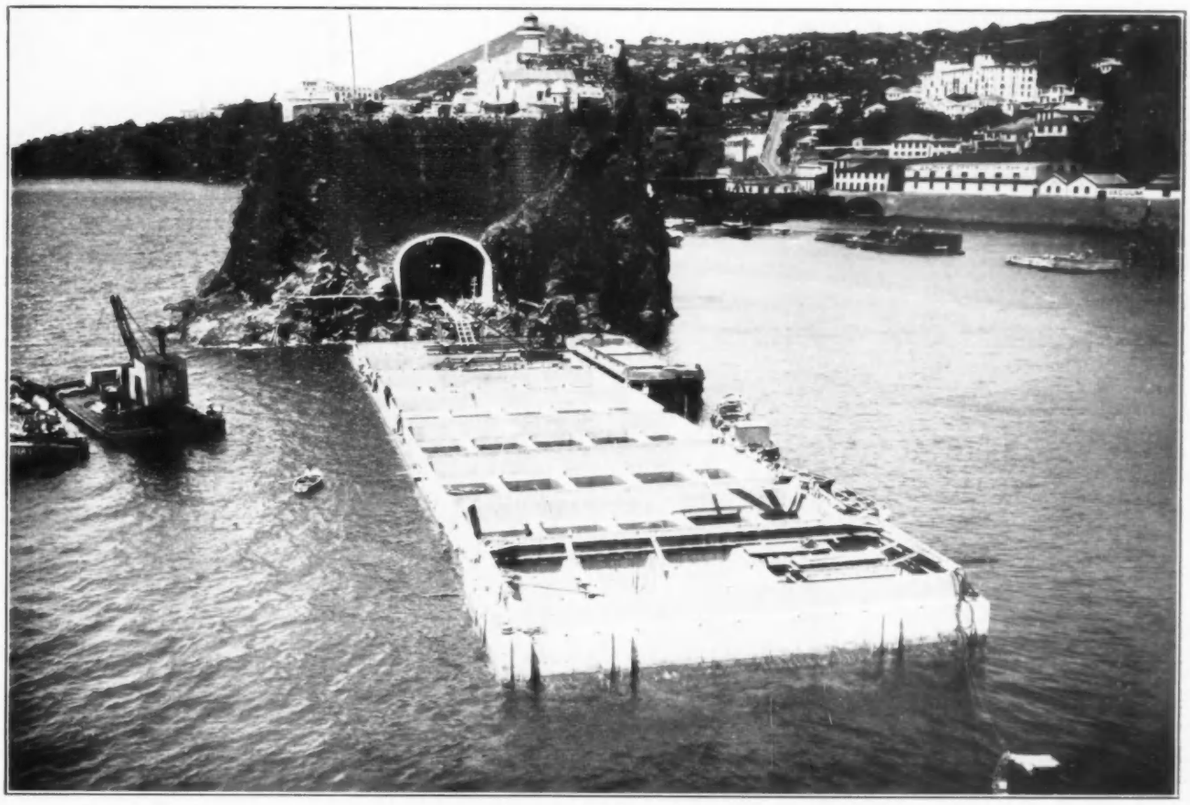

*Caisson construction in progress.*

Fig. 3 shows very well the construction of the stone mound foundation. The core consists of small fragments mixed with stones of larger dimensions. The exterior parts are formed by stones of weight up to 3 tons and even higher than 3 tons.

The stabilisation of the stone foundation, that is to say, the protection of 45 metres on the sea side, is formed by a layer, 1.5 metres thick of small stones, and by a layer of large stones up to 3 tons in weight.

The foundations, constructed in this matter, remained for about two years without load and later, with the weight of the superimposed cellular blocks and under the action of the waves of a slight storm that occurred on the 24th of December, 1936, only exhibited settlement of little consequence.

# *The Port of Funchal, Madeira*



*Breakwater under construction.*

*View of Beach some 8 kms. West of the Harbour, where shingle and sand for concrete, as well as small stone for the filling of the cellular blocks in the Breakwater are being excavated and sorted.*

## *The Port of Funchal, Madeira—continued*

**(b) Reinforced Concrete Blocks.**

These are constructed as indicated by Fig. 2 and the photographic views.

They have extenior walls, 0.60 m. in thickness and interior dividing walls, 0.25 m. in thickness. The interior walls divide the hollow block, into five compartments of which the two exterior ones are eventually to be filled with concrete and the interior ones with stone. The longitudinal walls (18 metres in length) have four grooves in order to facilitate filling up the space between two blocks with concrete.

The proportions for the concrete used for the construction of the blocks are 350 kilos of cement to 400 litres of sand and 800 litres of shingle. The percentage of reinforcement is 61.5 kilos per cubic metre of concrete. The blocks were constructed on an inclined plane with an inclination of 1/5 until they reached a height of 6 metres and then launched into the sea, it being verified that they all floated satisfactorily. While immersed their height is increased to 14.5 metres with the help of metal frames which are fixed to their walls, for which purpose appropriate holes had been made. The frames, after the concrete is three days' old are dismantled and fixed again on the upper part of the wall just constructed, by the means of holes which have been left. And thus by stages of 1 metre, 1.5 metres, or 2 metres the block continues to be constructed until it reaches a height of 14.5 metres.

*Passenger Pier under construction.*

Attaining this height, the blocks are laid on the stone mound foundation which has previously been properly prepared by divers. The setting is done, taking advantage of calm days, with the help of powerful tackle which places the blocks in alignment. Once placed in alignment, two valves are opened and water is permitted to enter into the compartments, causing the blocks to subside gently on to the foundation. With this system a fairly correct alignment of blocks is obtained, the displacement not exceeding 10 centimetres from the axis.

Once laid in position, the interior compartments are filled with shingle and the exterior ones are emptied to be filled with concrete composed of 180 kilos of cement to 400 litres of sand and 800 litres of shingle with 20 % of large stones. It should be said here that the transverse walls of the blocks, 9 metres in length of 0.60 in thickness, are not able to resist the exterior water when the two extreme compartments are emptied and cleaned to receive the concrete. For this reason the contracting firm placed wooden stays conveniently arranged so as to reduce the span from 9 metres to 4.5 metres. As the compartments become filled with concrete, the wooden stays are removed.

In the year 1936, ten blocks were laid which were filled with shingle and concrete before the winter.

The slight storms which occurred during the winter in the Port of Funchal did not displace the blocks, which, filled in the manner indicated weigh about 6,000 tons. Only a small number of blocks have so far been satisfactorily bedded as was to be expected. Possibly during the present summer nearly all the remaining blocks will be laid and filled with shingle and concrete.

This shows the sound construction of the stone foundation both as regards the gradation and the nature of the material employed.

**(c) Superstructure.**

Upon the ten blocks that have been deposited and filled during the past year a super-structure will be laid this year, comprising a shelter wall and parapet on the sea side and a quay wall on the port side, as shown in Fig. 2. The space between these two walls is to be filled with shingle and covered with a layer of reinforced concrete joining the two walls together. The pavement is placed upon this layer.

The shelter wall and parapet on the sea side and the quay wall on the port side are of concrete composed of 180 kilos of cement to 400 litres of sand and 800 litres of shingle with 20% of large stones. As, however, this mixture is considered poor it was decided that the exterior sides of each wall between the depths of (2.50) and (6.57) which are in contact with the sea water in consequence of tidal and wave action, should be constructed 1 metre thick in concrete of 350 kilos of cement to 400 litres of sand and 800 litres of shingle, this being a composition that forms a concrete considered sufficiently impervious.

These two compositions forming the same wall are deposited simultaneously in the same mould so that the concrete intermingles and constitutes a monolith. As the shelter wall has a height of 11 metres above the blocks, and one layer of reinforced concrete suffices to make a more or less solid reinforcement between the shelter wall and the quay wall, it was considered advisable to construct stanchions upon the longitudinal walls of the blocks, 9 metres apart, connecting the block walls to the shelter wall. With the aid of these stanchions the resistance of the shelter wall, against the action of the waves, will be greatly increased.

**Guard Blocks.**

The dimensions of the guard blocks, that is to say, the blocks which protect the stone mound foundation to a depth of (—12.00) adjoining the bottom of the cellular blocks, are 2m x 3m x 4m and weigh 60 tons. They are constructed of concrete composed of 300 kilos of cement to 400 litres of sand and 800 litres of shingle. The contracting firm took advantage of the inclined plane where the cellular blocks had been constructed to construct these blocks in the same position, after which they were launched into the sea down the inclined plane.

A floating crane afterwards transported them to their final destination.

Before being launched into the sea the blocks are in the building yard for 60 days in order to carbonate the lime which makes the exterior layer of the concrete waterproof.

## *The Port of Funchal, Madeira—continued*

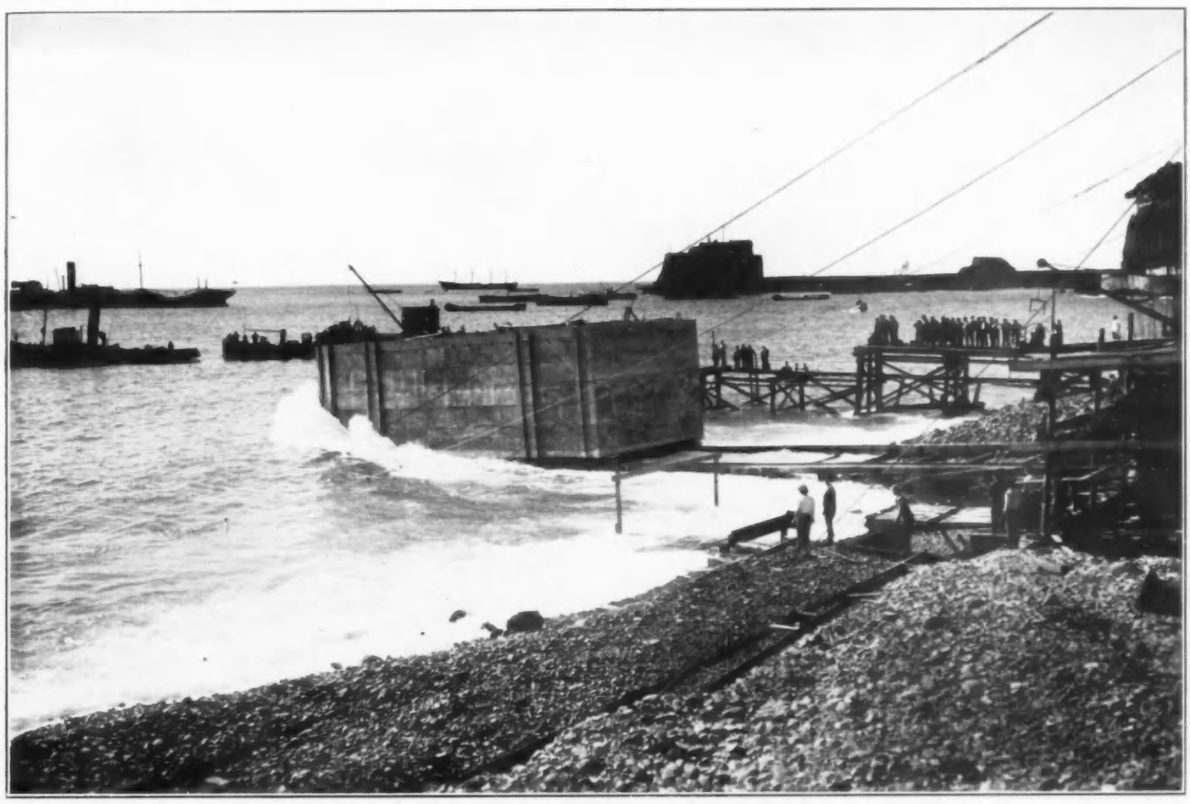
### Material for Construction.

One of the difficulties existing in Funchal is to find sand in sufficient quantity and of suitable quality for the execution of an important work. It was therefore decided to make use of a beach in which the sand was mixed with shingle in a proportion of about 30% of sand to 70% of basaltic shingle.

The contracting firm installed a machine on that beach for washing and preparing the material. From this machine, washed sand was obtained up to 4 cm. for reinforced concrete; and washed shingle graduated up to 6 cm. for concrete. Superior dimensions to these are utilised for the stone foundation and stones used for cyclopean concrete.

## *Materials and Plant for Funchal Breakwater*

The following supplementary data has been furnished by Herr Knud Hojgaard, C.E., President of the Danish Engineering and Contracting Firm Hojgaard and Schultz Ltd., Copenhagen, who are associated with the Contracting Firm Sociedade de Empreitadas e Trabalhos Hidraulicos Lda. and who are responsible for the alternative scheme of constructing the breakwater by means of huge cellular reinforced concrete blocks (caissons).



*A Cellular Block launched into the sea by means of the slipway.*

The cement is received from the Continent in ships with sealed holds. No lot of cement is utilised until the laboratory analysis has indicated that the cement has the necessary qualities for maritime works.

From the concrete, numerous cubes of 20 cm. are taken to be tested in the laboratory for resistance and permeability.

The cubes from compositions containing 350 kilos of cement have given up to now an average resistance of 382.6 kilogrammes per square centimetre at 28 days old and 428.7 kilogrammes per square centimetre at 84 days old.

### Sea Front Avenue.

In addition to the above described works of a marine character, a sea front avenue, in front of the pier at the entrance of the town, will be executed under this same tender.

This avenue has nothing of importance to call for special reference. It is a work of embellishment which required to be done. At the end of this avenue, wharfs will be built for the traffic in regional merchandise, that is to say for boats carrying about 20 tons of cargo.

The total cost of the work amounts to Esc. 32.950.000$00, including the reinforcement of the stone foundation. The cost of the avenue amounts to Esc. 6.800.000$00 and the 314 metres of breakwater will therefore amount to Esc. 26.150.000$00.

### Present State of the Work.

Up to the present date the contracting firm has executed work for a sum of about 20 Million Escudos, which corresponds to the construction of the stone foundation and part of the reinforcement of the same, the building of 32 cellular blocks, the placing and filling up of 29 of these blocks and the building of a part of the super structure; furthermore some 170 guard blocks have been made and 120 of these placed on the stone foundation.

The works, according to contract, will be finished in October, 1939, but it is believed that the contracting firm will finish a little sooner.

### Quantities of Materials used for the Construction of the Breakwater.

| | |
|---|---|
| Stone in mound foundation and for filling the caissons ... ... ... | 180,000 cu. m. |
| Shingle for concrete ... ... ... | 70,000 cu. m. |
| Sand for concrete ... ... ... | 40,000 cu. m. |
| Cement for concrete ... ... | 20,000 tons |

### Preparation and Transport of Materials.

The cement is furnished by the Portuguese Cement Work, Secil, situated at the Harbour of Setubal, some 40 kms. south of Lisbon.

All the other materials are of local origin and are being prepared at various places not far from the harbour.

The stones for the foundation of the breakwater are divided into three groups, namely—

(1) Mixed stones of all sizes weighing up to 1,500 kgs.

(2) Stones weighing from 1,500—3,000 kgs.

(3) Stones weighing more than 3,000 kgs.

The stones of the last group are for the purpose of covering the outer slopes of the foundation.

Shingle and small stones weighing up to 10 kgs. are found in ample quantities on various beaches not very far from the harbour. As regards the larger stones, the original plan was to get them from a quarry to be opened in one of the basalt rocks near the shore. This method would, however, be comparatively expensive and inconvenient, and, therefore, the contracting firm in preparing their tender based their calculation of price on the assumption that it would be possible to obtain the necessary quantity of large stone by collecting stone blocks from the bottom of the sea along the shore. This method has been carried through successfully, although the work is rather difficult because of the swell. The subaqueous collection of

## *The Port of Funchal, Madeira—continued*

*Floating Crane lifting heacy stones from sea bed. To the left is seen the partially-loaded tilting barge used for the transport and deposit of the stones at the breakwater.*

heavy stone is a speciality, which has been developed in Denmark, where almost all stone material for harbour work is taken from the shallow sea shores of the many islands. At Madeira, Danish divers and Danish lifting tackle adapted to the local conditions were employed.

The lifting plant consists of two 15 tons floating cranes, a diver working in conjunction with each crane. The daily output for each crane is 150-200 tons. The stones are loaded on to special barges, each having a carrying capacity of 200 tons. At the site of operations a tugboat is always ready to remove the cranes and barges in case of unfavourable weather . It should be noted that all this work is carried out on the open seaboard of the Atlantic Ocean without any protection whatsoever.

The loaded stone barges are towed to the site of the breakwater, where they are discharged by tilting; in this way 200 tons of stone can be deposited on the mound foundation in less than 2 minutes. The illustration below shows a barge from which the load of stone has just been tilted into the water.

The preparation of materials for the concrete required the erection of a special plant. It was particularly difficult to find the necessary quantity of sand, since there are practcially no sand beaches in the neighbourhood of Funchal. It was finaly decided to extract the sand from the so called Praia Formosa, a small bay some 8 kms. west of Funchal, where an area about 100 m. long and 80 m. wide is covered with shingle mixed with sand.

To obtain the 40,000 $m^3$ of sand required for the concrete it has been necessary to excavate and sift some 200,000 $m^3$ of material. This material, which mainly consists of shingles of sizes from 2 to 10 cms. diameter is excavated by hand above low water level and transported by small wagons, driven by motor locomotives, to the screening plant. The material contains some clay, which during heavy rain falls has been washed down from the hills, and it is essential that the material should be thoroughly washed. The water for washing is taken from the sea and 3 to 5 cu. m. of water are used for each cubic metre of material. In the screening plant the sand is separated from the stone and the shingle is sorted to various sizes.

From the screening drums the materials pass into silos, where they are stored until they are required at the breakwater. The transport is carried out by means of barges. Since it would be practically impossible to construct a quay, or even a temporary bridge, at this place the loading of barges is done by means of

*Tilting Barge used for the transport and placing of stone in the foundation.*

## *The Port of Funchal, Madeira—continued*

a bucket travelling on a steel cable, the upper end of which is fastened to the rock on the shore, while the lower end is attached to a heavy concrete block sunk into the water. By this arrangement, which is shown in the photograph on page 303, some 40 cu. m. of material may be loaded in an hour, a quantity which corresponds to the capacity of the screening plant.

**Plant Used for the Work.**

To the method of building the caissons already described in the article of Mr. Coutinho de Lima, it may be added that the caissons were constructed on 2 slipways each affording space for 2 caissons. It was thus possible to construct and launch 32 caissons in the course of 9 months during the year of 1935.

The concrete superstructure is constructed by means of a concrete mixer mounted on a moveable wooden tower, which in case of stormy weather can be removed from an exposed position on the breakwater.

The main part of the plant is floating and comprises more than 15 barges, 3 floating cranes with capacity up to 50 tons, 3 tugboats and a number of smaller units.

Heavy harbour work requires, of course, the installation of a comparatively large plant, and in the case of the Harbour of Funchal particular attention has been paid to the maintenance and preservation of the plant, for in case of damage or loss of important units very considerable time would be required to replace the necessary items. Conditions at Funchal are rather trying because all the work has to be done on the unprotected coast of the Atlantic Ocean.

The work has now been going on for 3 years and although there have been some setbacks, it must be said that so far it has been possible to carry out the work in accordance to the programme. Subsequent to the laying of the foundation for the breakwater, the caisson substructure and part of the superstructure have now been built and already some degree of protection for the floating equipment has been created, thereby decreasing the risk of further mishaps. Yet the danger of damage to the partly finished works will remain until the last batch of concrete has been placed in the superstructure of the breakwater.

# *Port of London Health Committee*

### *Excerpts from Report for the Year ended 31st December, 1936 of the Medical Officer of Health for the Port of London*

The tonnage of vessels entering the Port of London during 1936 showed an increase of 1,194,449 tons, as compared with the previous year, the total being 30,868,381 tons. 14,454 vessels arrived from foreign ports, and of these 2,389 were boarded and inspected by your medical officers.

Infectious disease was reported as having occurred during the voyage on 204 vessels, the total number of cases being 317, of which 174, including 94 of pulmonary tuberculosis, were landed in the port.

In the training ships there occurred two cases of scarlet fever, 10 of diphtheria, and one each of measles and mumps.

One case of diphtheria occurred on a house-boat moored in the district.

No case of plague occurred during the year on any vessel bound for London. Of the 2,508 rats examined bacteriologically, 983 were from ships and 1,525 were from shore premises. None showed any evidence of plague infection.

Six vessels arrived in which a total of nine cases of small-pox had occurred, but no case was actually landed in the port.

Your sanitary inspectors made 15,531 inspections of vessels and 6,070 inspections of shore premises. Three thousand, five hundred and fifty-six defects were reported in 2,643 vessels, in 2,492 of which the defects were remedied. Eleven hundred and eighty-four nuisances were reported in 1,170 shore premises, in 1,166 of which the nuisances were abated.

Nuisance from smoke was reported in 36 vessels, and in 14 instances a Statutory Notice was served on the master.

The number of vessels fumigated for rat destruction under the supervision of your inspectors was 118—72 by hydrogen cyanide and 46 by sulphur dioxide. By the former method 879 rats and 34 mice, and by the latter 916 rats and 41 mice were destroyed.

The average number of rats killed per fumigation was 15.2. If mice are taken into consideration also, the average number of rodents destroyed per fumigation was 15.8. In addition, 4,968 rats were trapped in ships and 5,016 on shore in the port.

The number of water barges in use in the port remained at 12. As in previous years, the annual re-registration of these water barges with the Port of London Authority was made conditional upon the satisfactory reports of your officers as to the fitness of the barges for the carriage of drinking water. These arrangements continued to work smoothly.

During the year 3,288 tons of foodstuffs were condemned as unfit for human consumption, and were either destroyed or disposed of for industrial purposes.

In regard to the Port of London Houseboat Bye-laws which are being made jointly by yourselves and the Port of London Authority, under the City of London (Various Powers) Act, 1933, agreement has been reached with the Port of London Authority and the Ministry of Health. The proposed Bye-laws have been advertised by the Port of London Authority, and objections are now receiving consideration. It is hoped that it will be possible to issue the Bye-laws before the end of 1937.

No complaints were received during the year as to the pollution of the river by sewage discharged from the Northern and Southern Outfalls. This was due to the heavy rainfall which resulted in the river being flushed with fresh water from above Teddington.

Signed by Charles F. White,
M.D., D.P.H.Vict., D.T.M. Liverpool.

THE FOLLOWING TABLE IS APPENDED TO THE REPORT.

(*a*) PASSENGER TRAFFIC DURING 1936:—

TO AND FROM NON-EUROPEAN COUNTRIES.

| Number of Passengers | 1st Class | 2nd Class | 3rd Class | Tourist |
|---|---|---|---|---|
| Inwards ... ... | 18,939 | 8,370 | 10,793 | 15,792 |
| Outwards ... ... | 21,215 | 5,977 | 1,825 | 17,574 |

TO AND FROM CONTINENT OF EUROPE.

| | |
|---|---|
| Inwards ... ... ... ... ... ... | 64,530 (all classes) |
| Outwards ... ... ... ... ... ... | 58,348 (all classes) |

Countries from which passengers principally arrive: North America, Australia, Europe, British South Africa, India and the Far East.

(*b*) CARGO TRAFFIC:—

Principal Imports—Merchandise of all kinds, principally Provisions, Fruit, Grain and Flour, Hides and Skins, Meat, Oil and Fats, Rubber, Textile Materials, Tobacco, Wood and Wool.

Principal Exports—Manufactured Goods of all kinds.

# *Labour Conditions at British Ports*

### *Impending Changes*

We have previously commented upon troubles in connection with dock labour on the Continent, and it was hardly likely that the legal adoption of the 40-hour week at French and Belgian ports would fail to have an influence on conditions of labour at ports elsewhere. Whether this is the case in regard to English ports is, of course, a matter for conjecture, but it is significant that, on May 31st last, the Dockers' Union presented to the employers certain demands, including an increase of pay of 4s. per day on the daily minimum rate, involving a corresponding increase in regard to piece-work rates, together with a guarantee for a daily minimum in place of a half-day minimum. A further demand had reference to an increase in overtime rates at the week-end. Both these demands were under consideration by the National Joint Council for Dock Labour during July and August, when the employers put forward alternative proposals involving a far-reaching re-organisation of the industry with a view to extensive decasualisation of employment. These counter-proposals proved to be unacceptable to the men, and the matter was further considered at a meeting of the Council, which was held in London on August 17th.

As an outcome of this conference, the following official statement was issued:—

"The negotiations between the port employers and the dockers' unions, which have been going on for some time, reached a definite stage to-day, when both sides decided to recommend to their constituents acceptance of a settlement, the principal points of which are as follows:—

"(1) Dockers' rates of pay to be increased by 1s. per day on the present half-daily basis. This increase to apply both to time-workers and piece-workers in conformity with the National Agreements, and to come into force on September 20th, 1937.

"(2) Both sides immediately to get together to devise methods to give greater security of tenure to the dock worker, a framework of suggestions to be sent to the individual ports this week for their detailed consideration. As part and parcel of this scheme, there will be considered methods to give financial assistance to the older men who may be dispossessed of registration tokens by any schemes which may be adopted, and a method of making provision for holidays with pay."

At the time of writing, the matter stands as above. Negotiations are in progress for a settlement on the basis indicated, which it is hoped will lead to a definite agreement satisfactory to both parties.

# The Dredger "Chien She"

## *Description of a Powerful New Dredger built to the order of the Whangpoo Conservancy Board*

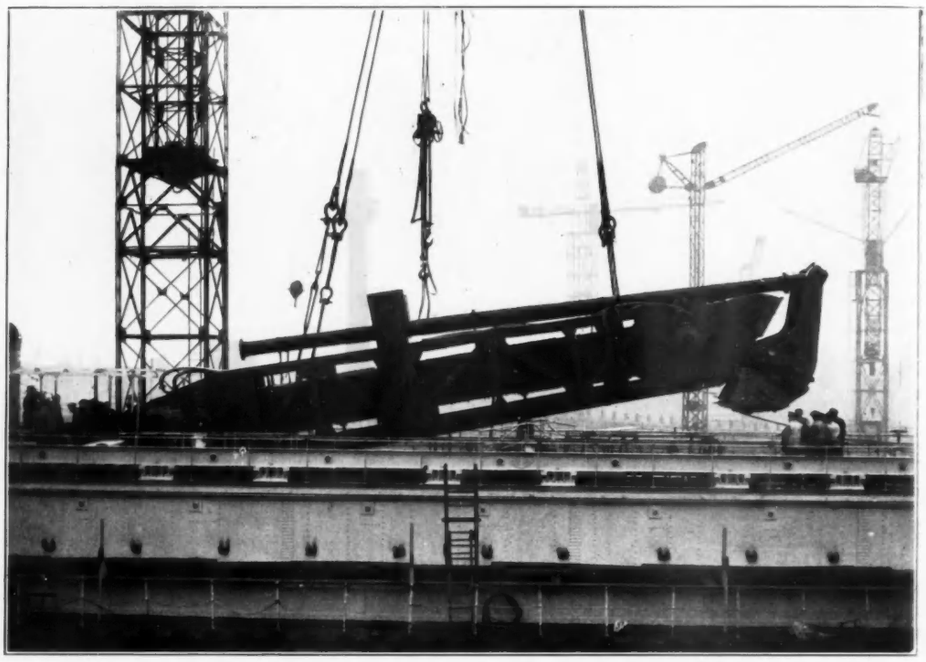
*By HERBERT CHATLEY, D.Sc., M.Inst.C.E., Engineer-in-Chief*

*(ABRIDGED)*

*(continued from page 282*

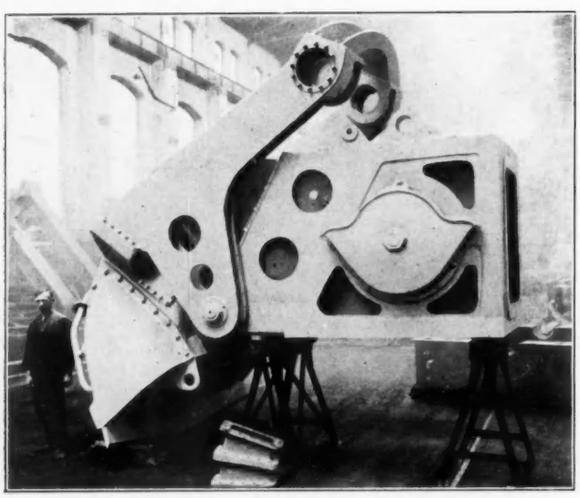
The lower part of the outboard suction is fitted with an inter-changeable cast steel suction drag head of massive design and construction, fitted at the entrance with manganese steel cutting blades, and having vertical grid plates for the purpose of excluding large objects and wreckage from entering the pump. Three different sizes of drag heads have been supplied, measuring six, eight and ten feet respectively on the cutting edge, one of which is illustrated. The inner surfaces are streamlined throughout, and the head is cast with a water jacket fitted with pressure water jet openings facing in the direction of flow of the spoil, which can be used to provide water lubrication on the inner skin of the casting when dredging stiff materials.

Another interesting and important feature of the drag head is the mechanism for maintaining a constant angle at the cutting edge of head irrespective of dredging depth, tidal variation or loaded conditions of the dredger.



*General View of the Suction Ladder and Draghead.*

This arrangement, which is shown in the illustration, consists of two cast steel, lever-shaped arms, mounted on top of the drag head, connected at the upper end to a branch piece, the ends of which form a journal rotating in the lever ends. These side arms are cast hollow, and serve to convey the pressure water service to the water jacket in the drag head. The branch piece joins a "Mannesman" solid drawn steel pressure water pipe, which in turn is connected to a second cast steel branch piece mounted on bearings secured to the forward end of the centre well. By means of this mechanism, the cutting angle of the drag head, after having been set to suit the conditions of dredging, remains fixed for any position of the head, the variation of angle being taken up by a sliding sleeve secured to the upper part of the drag head. A general view of the suction ladder with drag head attached is shown.



*Side View of Draghead showing Side Levers for Angle Control.*

The suction ladder is housed within the centre well, and has heavy wood-faced fenders on both sides, which bear on doubling plates on the well sides during dredging. The lower end of the suction pipe and ladder is suspended from the hoisting platform by steel wire ropes, raised and lowered by means of the hoisting winch already described. A view of the centre well and suction ladder is shown, showing the drag head in the top position.

The main dredging pump is of the centrifugal type, built of cast steel sections bolted together and lined internally with manganese-steel wearing plates. The impeller is of the semi-shrouded type 8'-6" diameter over tips, having four mild steel blades, 20" in width, riveted to vanes cast on to the impeller disc. The impeller shaft is $13\frac{3}{4}$" diameter at the bearing, and connects through a "Michell" type thrust block to the main pumping engine. The impeller shaft bearing is fitted with a patent sand excluding device, to which a supply of clean water under pressure is kept in circulation.

The pump and impeller has a water-pumping rate of 18,000 tons per hour at a speed of 120 revolutions per minute when delivering through the distributors at the hopper tops, and when dredging thick mud, having an in sitû density of 1.8, the pump can fill the hoppers with a load of 4,000 tons in less than 20 minutes.

The arrangement of suction and delivery piping and valves makes it possible to draw the dredged-up material from the drag head and deliver it direct to the hoppers, or if required, it may be pumped overboard for reclamation purposes. It also permits of the hoppers being pumped out and discharged overboard.

Each particular method of pumping is controlled by manœuvring appropriate sluice valves in the suction and discharge pipes, all of which are hydraulically operated by control levers, arranged in the operating room on the bridge deck. The main discharge pipe from the pump is divided at the main deck level into two separate discharge pipes leading to the port and starboard hoppers respectively, each having five outlets or distributors spaced at intervals along the length of the hopper and fitted with a hydraulically-operated sluice valve for control of the loading, and to ensure an equal distribution of the load in the hoppers.

## *The Dredger "Chien She"—continued*

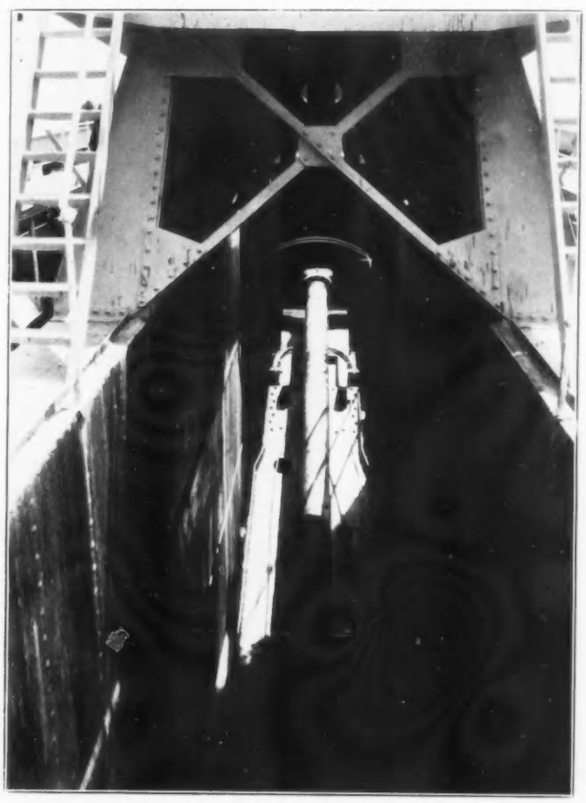
Particulars of the various suction and discharge connections are given in the following Table:—

| Description | Number | Dimensions Millimetre | Dimensions Inches |
|---|---|---|---|
| Maximum opening at entrance to 8-ft. draghead | — | 2,400×900 | 96-in.×35½-in. |
| Suction opening in draghead crown ... ... ... | 1 | 1,100×900 | 43⅜-in.×35½-in. |
| Section of Outboard suction pipe ... ... ... ... | 1 | 1,200×800 | 47¼-in.×31½-in. |
| | | Diameter | |
| Main dredging pump suction | 1 | 1,100 | 43⅜-in. |
| Pump suction branches from hoppers ... ... ... | 2 | 700 | 27½-in. |
| Pump suction from sea ... | 2 | 300 | 11¾-in. |
| Mixing water sea valves ... | 10 | 560 | 22-in. |
| Main dredging pump discharge ... ... ... | 1 | 1,000 | 39¾-in. |
| Overboard discharge pipes ... | 2 | 1,000 | 39⅜-in. |
| Discharge pipes to hoppers | 2 | 700 | 27½-in. |
| Discharge outlets to hoppers | 10 | 450×586 | 17¾-in.×23-in. |
| Pressure water pump sea suction ... ... ... | 1 | 450 | 17¾-in. |
| Pressure water pump discharge ... ... ... | 1 | 400 | 15¾-in. |
| Pressure water connection to doors .. ... ... | 1 | 100 | 4-in. |
| Clear openings in bottom for dumping ... ... ... | 10 | 2,060×2,230 | 81-in.×88-in. |

Independent sea inlets, each fitted with hydraulically-operated sluice valves, are arranged, five on each side of the vessel, with short inlet pipes leading to the lower compartments of the hoppers. These inlets are placed directly opposite the suction openings from the hoppers, and are used for diluting the hopper mixture when the load is being pumped overboard from the hoppers.

A double-stage centrifugal pump, having both chambers working in series constructed by the builders, is installed in the pumping engine room for the supply of high-pressure water to the drag head water jets, and also to the bottom door frames for cleaning the joints after the spoil has been dumped.

The pump has a capacity of 2,500 gallons per minute against a head of 150-ft., or 6,000 gallons at 30-ft. head, and is driven direct by a set of vertical compound, enclosed type, engines developing 290 i.h.p. at 325 revs. per minute.

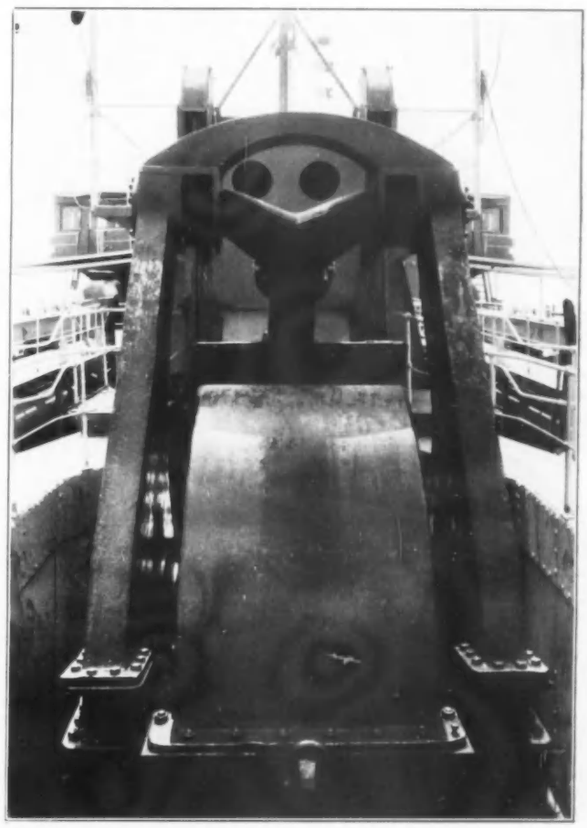


*View showing Centre Well and Suction Ladder.*

Two steam-driven hydraulic pumps are also installed for providing the necessary high-pressure water supply to the various hydraulic rams and sluice valves in connection with dredging equipment. The pumps are of the vertical duplex, long-stroke type, arranged to work at a water pressure of 750 lbs. per sq. inch, the door rams being operated at about 600 lbs. per sq. inch, and the individual sluice valves at a reduced pressure of 250 to 300 lbs. per sq. inch. The pumps are fitted with regulator controls on the steam and water ends of the system.

### Pumping Machinery

The main dredging pump is driven direct by a single vertical triple expansion, marine-type steam engine having cylinders 500 m/m.—820 m/m.—1,350 m/m. diameter respectively, by 950 m/m. stroke (19$\frac{11}{16}$"-32¼"-51$\frac{31}{16}$" × 37⅜") capable of developing 2,400 i.h.p. at a normal speed of 150 revs. per minute.



*Suction Ladder and Draghead in Top Position.*

The engine is of substantial construction, designed for a moderate degree of super-heat, with crank shaft arranged in three interchangeable sections, ahead and astern valve motion and reversing gear, and fitted with a dead-weight sensitive governor. The pistons are fitted with Lockwood and Carlisle packing rings, and the rods with patent metallic packing. The cylinders are well insulated and entirely enclosed by portable polished steel covers.

The pumping machinery, which is installed in a separate engine room situated forward of the hopper spaces, is entirely independent from the propelling machinery, having its own condensing plant and auxiliary machinery, which can be shut down when the dredging operations are suspended.

The pump room auxiliaries are all steam driven, and comprise the following units:—

One Weir's Regenerative Condenser, 3,200 sq. ft., constructed by the builders, a "Weir's" Paragon-type air pump, a 12-in. centrifugal circulating pump, a duplex cylinder condensate pump with automatic control from filter tank; bilge, ballast and gland pressure water pumps, and as already mentioned, the large high-pressure water jet pump and a pair of powerful duplex pumps for the hydraulic pressure system.

On the starboard side of the pump room a well-equipped workshop is arranged in a separate enclosure, over which is situated a spacious pump-room store.

### Propelling Machinery

The propelling machinery consists of twin sets of triple expansion surface condensing steam engines having cylinder 480—800—1,300 m/m. diameter by 750 m/m. stroke. (18⅞"-31½"-51$\frac{31}{16}$" × 29½"), capable of developing a total of 3,000 i.h.p. at a normal speed of 130 revs. per minute. The working parts are designed for super-heated steam. The engines are entirely independent for propelling purposes, with crank shafts in three interchangeable sections, fitted with "Michell" type patent thrust blocks, and driving four-bladed cast-iron propellers. All

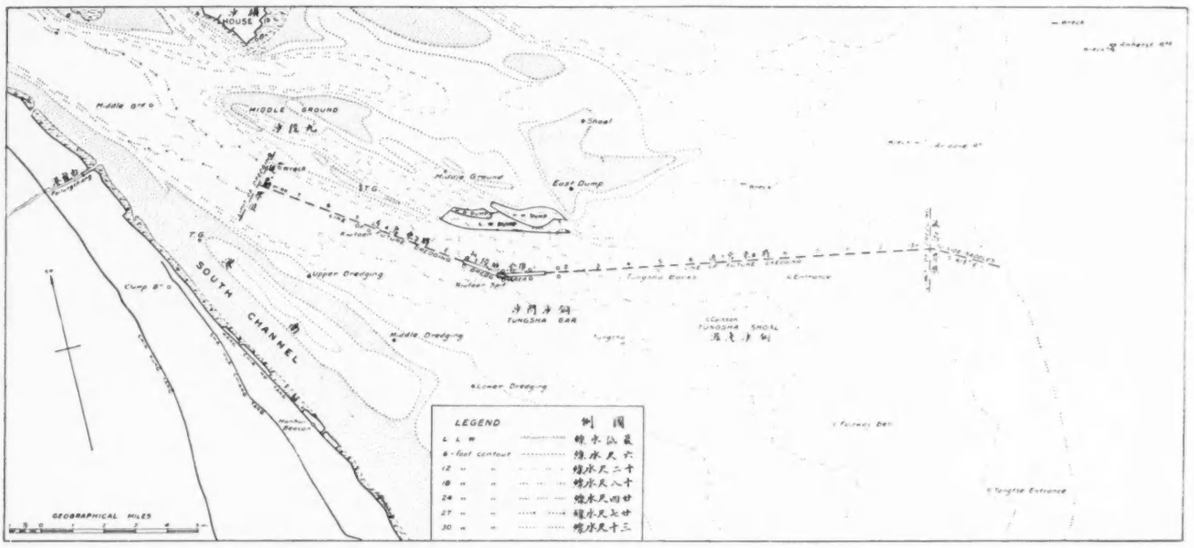
*The Dredger "Chien She"—continued*

**WHANGPOO CONSERVANCY BOARD**

**REVISED LOCATION OF INITIAL DREDGING ON THE YANGTSE BAR 1935-6**

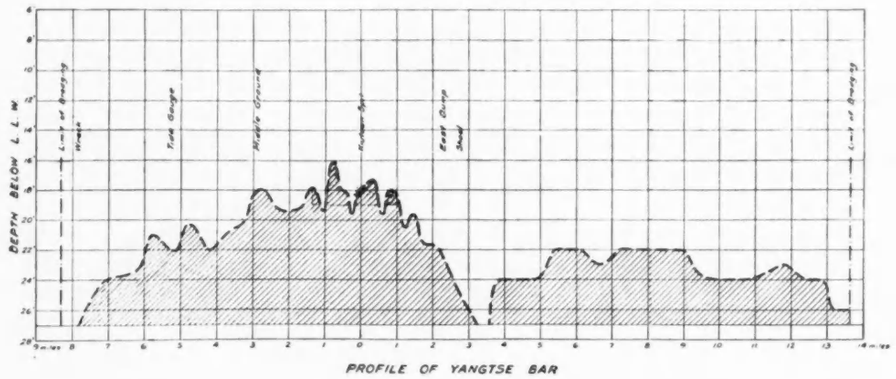
SURVEY OF 1935

SCALES AS SHOWN




the pistons are fitted with Lockwood and Carlisle packing rings, and the rods with patent metallic packing. The cylinders are well insulated and entirely enclosed on top with portable covers of planished steel sheets lined with asbestos material. The stern tube bushes are of cast iron, fitted with Vicker's type sand-excluding glands.

A large range of steam-driven auxiliaries is provided for the feed-water system and general service duties, including:—One Weir's regenerative-type condenser, common to both engines, having a cooling surface of 3,200 sq. ft., constructed by the builders, Weir's main and auxiliary feed pumps with automatic feed control, Weir's "Paragon" type air pump, Weir's 10-ton evaporator and fresh-water distilling apparatus, 12-inch centrifugal circulating pump; and the usual bilge, ballast and general service pumps. In addition, an independent auxiliary condensing equipment is provided for port and stand-by use, comprising: A Weir's type condenser, "Mono-type" air pump, and a 6-in. centrifugal circulating pump.




The suction side of the feed-water system connects to a gravitation type-feed water filter of large capacity, into which the condensate water from the pumping and propelling engine room is directed, together with drains from all the main and auxiliary machinery. The feed water passes from the filter by automatic control to the main feed pumps, and is discharged through a Weir's "Multiflow" type surface-feed water heater before entering the boilers.

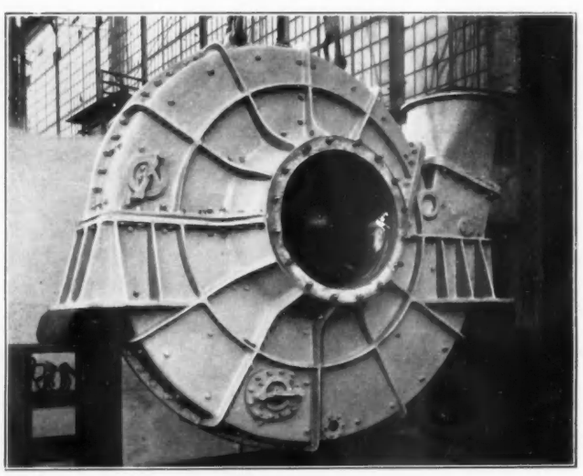
A No. 6 "Hall's" $CO_2$ refrigerating machine is installed at the after end of the engine room adjoining the insulated chambers, while two vertical compound steam-generating sets, supplied by the builders, each driving a 16 K.W. Siemen's dynamo, together with a 12 K.W. "National,"—"Lawrence Scott" Emergency Diesel dynamo set, supplied by the National Gas and Oil Engine Co., Ltd., Ashton-under-Lyne, completes the auxiliary equipment in the propelling engine room.

**Boiler Room Installation**

The steam-generating equipment consists of four single-ended, cylindrical return tube, four furnace boilers, each fitted with super-heater and arranged for operating under Howden's system of forced draught in a common open stokehold, the furnace fronts being arranged for coal or oil fuel burning. The boilers, super-heaters, and fan units have been supplied by the builders from their works at Elbing, the furnace fronts by Messrs. James Howden and Sons, Ltd., Glasgow, and the oil fuel equipment by The Wallsend Slipway and Engineering Co., Ltd., Wallsend-on-Tyne.

The boilers are each 17′ 1″ mean diameter × 12′ 11″ mean length, constructed with a single shell plate for a working pressure of 200 lbs. sq. inch, the steam being super-heated to 610° F. in order to compensate for pressure drop in the long main steam range to the forward engine room. One of the four main boilers is shown under construction, also a view of the after-stokehold.

The total heating surface of the four boilers is 13,760 sq. ft., the grate area 328 sq. ft., and the super-heater surface 540 sq. ft. Each pair of boilers is fitted with a "Ranarex" $CO_2$ recorder, and two "See's" ash ejectors are installed for discharging the ashes. Soot-blowing arrangements are fitted to each boiler. Under service conditions the boilers are capable of supplying steam for all purposes, under natural draught con-



*Main Dredging Pump.*

## *The Dredger "Chien She"—continued*

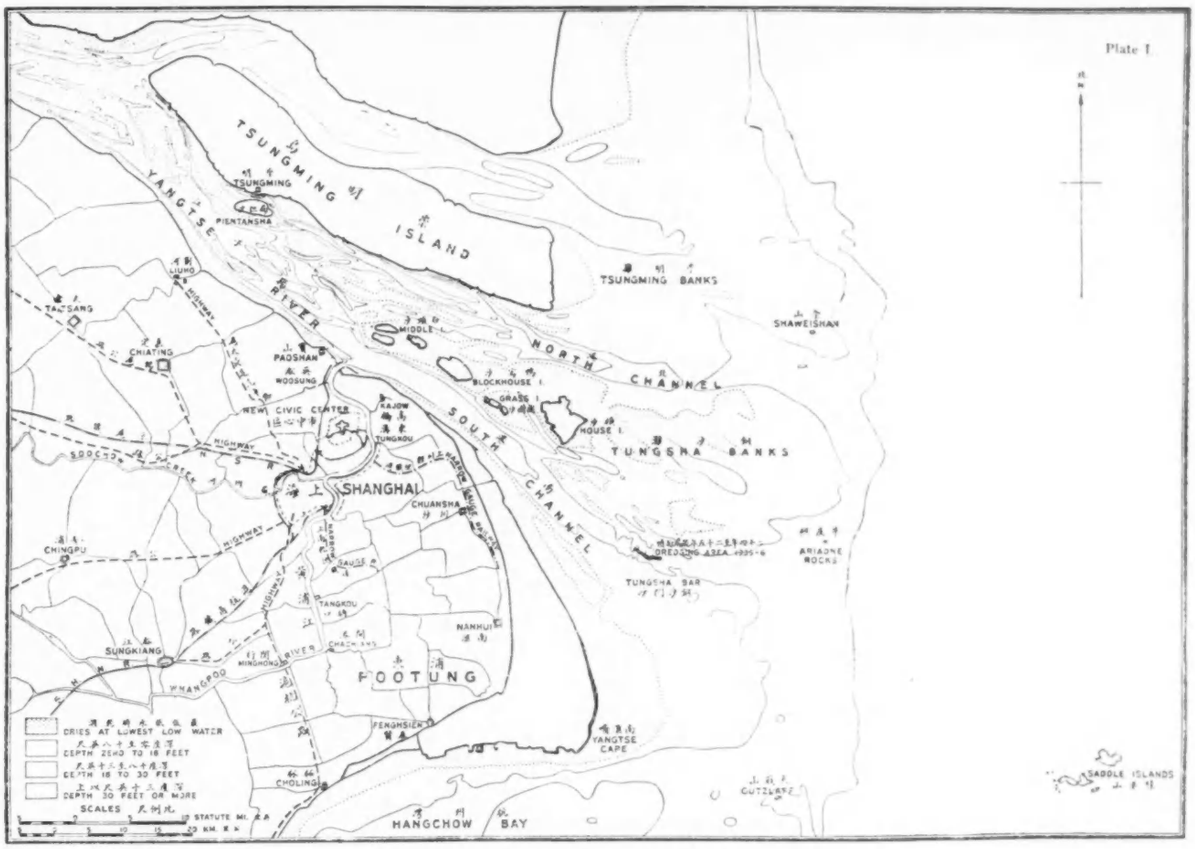



*Chart showing the Approaches to Shanghai.*

dition when burning a good quality of Chinese coal having a calorific value of about 14,000 B. T. Us per pound.

*Dredging Pump Impeller.*

### Electrical Installation

The vessel is fitted throughout by electricity, the current being supplied from the steam-generating sets installed in the propelling engine room. In addition to the deck and accommodation lights, four powerful flood lights are fitted on posts over the dredging well for working at night, also a 6,000 Watt searchlight is installed and arranged for working from the navigating bridge.

The main switch board is composed of polished "Sindanyo" panels built on a steel framework and arranged with the usual light and power circuits, switches and cut-outs. The instruments and fittings are of Siemen's make.

### Trials and Delivery

The keel of the "Chien She" was laid in the Danzig yard of the builders on the 1st March, 1934, and on September the 15th, the vessel was successfully launched by Madame Liu Chung Chieh, wife of His Excellency the Chinese Minister at Berlin.

Before leaving on the voyage to Shanghai the dredger carried out a series of preliminary dredging and speed trials at Pillau at the entrance to the Konigsberg Canal, in mid January, under unusually severe cold-weather conditions.

The "Chien She" arrived at Shanghai on the 14th April, 1935, and after docking for adjustment of the hopper doors and re-assembling of the dredging equipment, the vessel was put into service condition and proceeded on official trials, commencing on the 8th May, 1935. The trials prescribed in the Board's agreements with the builders were of a full and exhaustive nature, covering a period of 100 hours dredging at the Tungsha Bar in the Yangtsze Estuary, speed trials, endurance trials, and coal and oil fuel consumption trials.

These were successfully completed within 10 days of the commencement, the vessel showing a highly satisfactory performance on all trials.

The dredger was officially accepted by the Board as from the 3rd July, 1935, and thereafter was commissioned for service, commencing regular dredging operations at the Tungsha Bar on the 8th July, 1935.

### Progress of the Dredging Operations at the Yangtsze Bar

It was clearly demonstrated by the satisfactory performance of the dredger "Chien She" on the official trials and preliminary dredging operations at the Bar that the Whangpoo Conservancy Board has been particularly fortunate in the choice of this type of dredger for the important undertaking of dredging the Yangtsze Bar.

The mud, clay and sand materials comprising the Bar can be readily excavated, and further, the centre-well disposition of the drag head which has been incorporated in the design has proved eminently suitable for the tidal and weather conditions

## *The Dredger "Chien She"—continued*

| NAME OF DREDGER | "LEVIATHAN" | "CHIEN SHE" | "PIERRE LEPORT" | M.O.P.217c | "RIETBOK" |
|---|---|---|---|---|---|
| Year Built | 1909 | 1935 | 1934 | 1929 | 1930 |
| Builders | Cammel Laird | Schichau | Deschimag | Werf Gusto | Simons |
| Length B.P. | 465'-9" | 360'-0" | 337'-0" | 325'-0" | 374'-0" |
| Beam Moulded | 69'-0" | 60'-0" | 54'-0" | 52'-6" | 57'-9" |
| Depth Moulded | 30'-7" | 26'-6" | 26'-0" | 23'-0" | 25'-9" |
| Designed loaded draft | 23'-0" | 18'-0" | 19'-0" | 18'-0" | 18'-0" |
| Material designed for | Sand | Firm Mud | Various | Light Mud | Sand |
| Type of Dredger | Moored Suction Flexible head | Drag Suction Scooping head | Trailing Suction flexible head | Drag Suction Scooping head | Moored Suction Flexible head |
| Hopper Capacity, to Deck Level cub. yds. | 6700 | 3700 | 2610 | 2610 | 3700 |
| Dredging rate in cub. yards per hour | 8000 | Normal 8000 | 3300 | 8000 Contract (14000 Trials) | 4000 |
| Number and size of Suction pipes | 4 @ 42" | 1 @ 43" | 2 @ 25½" | 1 @ 37" | 1 @ 42" |
| I.H.P. of Pumping Engines | 2800 | 2400 | 2000 | 2000 | 1350 |
| I.H.P. of Propelling Engines | 4000 | 3000 | 3000 | 2000 | 3000 |
| Total I.H.P. of main Machinery | 6800 | 5400 | 5000 | 4000 | 4350 |
| Type of Machinery | Steam | Steam | Diesel Electric | Steam | Steam |
| Speed in knots, loaded | 10.5 | 11.0 | 11.0 | 9.0 | 11.5 |
| Maximum Dredging Depth in feet | 70' | 45' | 65' | 50' | No information |
| Location of service | Mersey Bar | Yangtsze Bar | Bordeaux Bar | Punto Indio | Durban Bar |

at the dredging site, the dredger "Chien She" being exceptionally easy to manœuvre in the prevailing cross currents when dredging at a speed of about three knots over the ground.

During the period the "Chien She" has been on service up until the end of July, 1936, a quantity of 4,296,110 cu. yds. of material has been dredged from the crest of the Bar, and deposited on the dumping area, about two miles distant from the dredging cut, in a total time of 2,271 working hours, resulting in a deepening of the channel of about 3-ft. over a width of 600-ft. and a distance of three miles.

This remarkable achievement is considered highly satisfactory, in view of the fact that over 60 per cent. of the output consisted of hard sand, which is not only difficult to dredge, but quickly settles in the mixture, resulting in a low average hopper density.

The situation of the line of dredging is shown on the chart of the Yangtsze Estuary.

### Particulars of the Five Largest Dredgers

The above table gives the principal characteristics of five of the largest Bar dredgers now in operation, from which it will be seen that the dredger "Chien She" is the largest and most powerful of the drag-suction type which has yet been constructed.

# *Dredging Operations at Iraq*

### *Launch of New Dredger*

Messrs. Wm. Simons and Co., Ltd., Renfrew, launched early in August, the drag suction hopper dredger "Basra," which to the order of the Crown Agents for the Colonies, acting for and on behalf of the Basra Port Directorate, they have constructed for work at Basrah, Iraq.

The dredger is fitted with two sets of triple expansion surface condensing engines, and steam is supplied by three cylindrical multi-tubular boilers, fitted with forced draught and oil-burning installation.

The dredging outfit consists of a set of triple expansion engines, driving a contrifugal pump, coupled to a suction pipe, fitted in a frame carrying a drag head, and has a dredging capacity of 2,000 tons of solids per hour. The suction frame is designed to dredge to a depth of 45-ft. under water and the hopper is of the dry bottom type arranged for discharging by the suction pump through suitable ducts with very extensive flushing and sluicing arrangements. Special arrangements are provided whereby the material may be discharged ashore or through a floating pipe line.

At the luncheon which was held subsequent to the launching ceremony, Major Andrew Brown, Chairman of Wm. Simons and Co., Ltd., gave some interesting particulars of the locality in which the new vessel would be engaged. He said that Basra, the Port of Iraq, was situated on the Shatt-El-Arab River, about 85 miles inland from the Gulf of Iran. This river was formed by the confluence of the large rivers Tigris and Euphrates, which brought down a very large quantity of silt. As a result of this silt, which formed bars at the mouth of the river, there had been no port facilities until dredging operations commenced. The presence of a large bar 15 miles long made it impossible for vessels drawing more than 20-ft. at high water to enter.

After the War a dredging scheme was inaugurated, following consultation between the port directorate and the late Sir Frederick Palmer, a well-known authority on river estuaries, and it was finally decided to cut a channel through this bar with the aid of drag suction hopper dredgers. Eventually orders were placed with Messrs. Simons for two dredgers of this class—the drag suction type—the "Liger," of 1,200 tons, and the "Tigon," of 2,000 tons capacity. These were delivered in 1925, while in 1935 they built a third dredger, the "Onger," to the order of the Crown Agents for the Colonies for the further development of the scheme. Dredging operations were so successful that there was now available a channel of 15 miles long and 300-ft. wide and of a depth suitable for modern cargo vessels as well as large oil tankers. The cargo vessels could sail to Basra and the tankers of the type of those of the Anglo-Iranian Oil Company to Abadan. Thus it was now possible for the vessels to carry their full loads to these ports instead of having to discharge about two-thirds of their cargoes at the bar, which then had to be lightered a distance up to about 100 miles.

### Houston Ship Channel Improvements.

The United States Engineering Department is preparing specifications for dredging the Houston Ship Channel to a depth of 36-37-ft. from Morgan Point up to Lynchburg and Green's Bayou. This depth has already been obtained from the Gulf across Galveston Bay to Morgan Point and the proposed work is part of a project for the entire channel.

# *Dock Entrance Reconstruction at Liverpool*

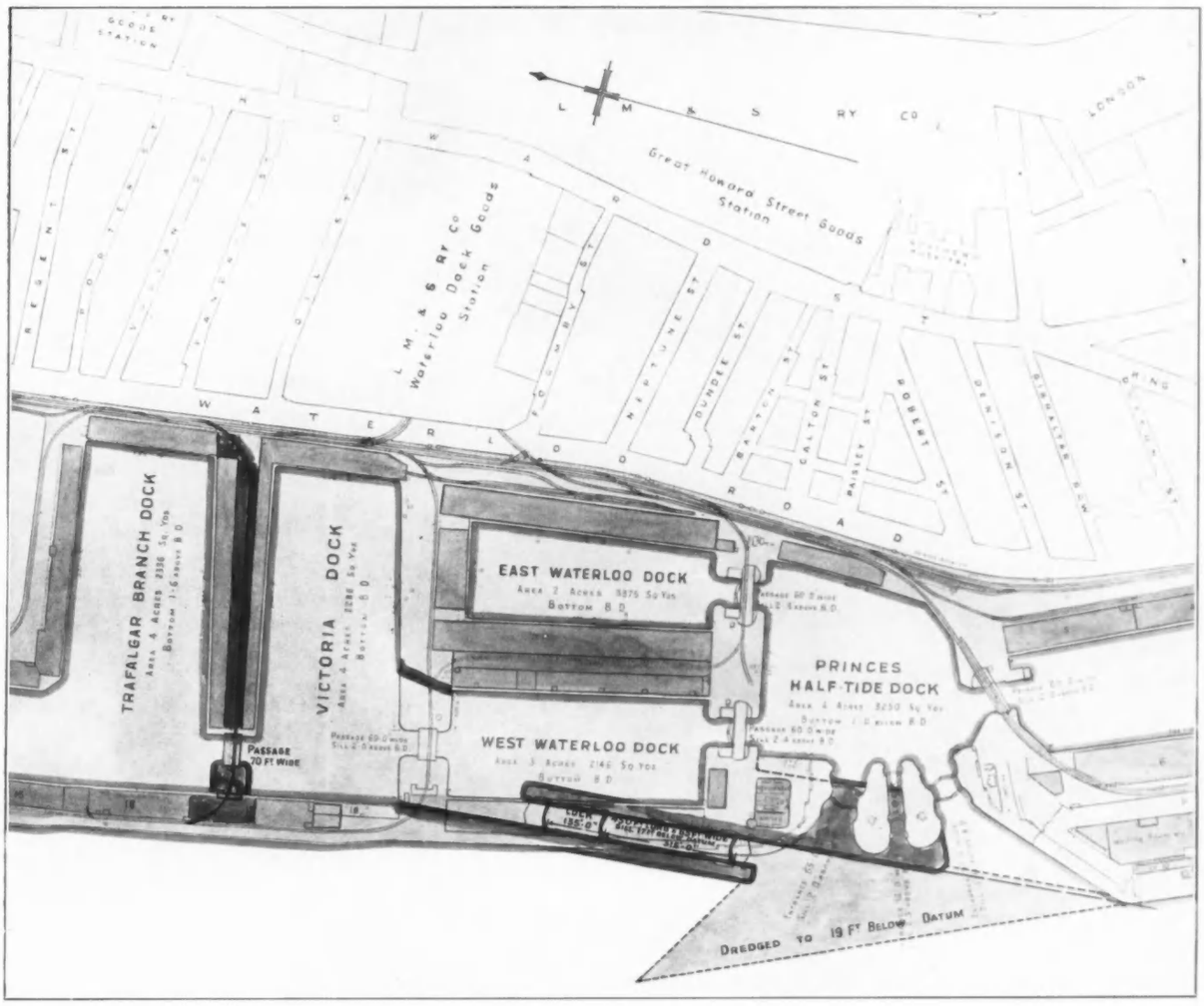
## *An Important Improvement Scheme*

Following previous preliminary notices in our issues of April and July last, of the decision of the Mersey Docks and Harbour Board to provide improved facilities for the docking and undocking of vessels engaged in the coastwise trade at Liverpool, we publish on this page a plan of the proposed reconstruction of the entrance to the West Waterloo Dock, together with particulars of the scheme and its objects, as courteously supplied by the Mersey Dock Board through their General Manager, Sir Lionel Warner, C.B.E., and the Chief Engineer, T. L. Norfolk, M.Inst.C.E.

Of the three adjacent existing entrances at the Princes Half-Tide Dock, two are to be filled in, while the third will be retained as an emergency exit. The fairway area outside the new entrance will be dredged to a depth of about 19-ft. below Bay datum.

The new lock is to be constructed in monolithic concrete, with granite facings. The gates will be of steel and greenheart. The work is to be carried out departmentally, with the Board's staff and men.

The formation of the new entrance involves some adaptation


L M & S RY CO
Great Howard Street Goods Station
L M & S Ry Co Waterloo Dock Goods Station
WATERLOO ROAD
TRAFALGAR BRANCH DOCK
VICTORIA DOCK
EAST WATERLOO DOCK
WEST WATERLOO DOCK
PRINCES HALF-TIDE DOCK
PASSAGE 70 FT WIDE
DREDGED TO 19 FT BELOW DATUM

*Liverpool Docks—Proposed New Entrance Lock to West Waterloo Dock.*

As will be seen from the plan, a new entrance lock, 450-ft. long, and 65-ft. wide, is to be constructed at the west side of the West Waterloo Dock, with a sill at 17-ft. 6-in. below low water spring tides, which will enable vessels drawing up to 17-ft. of water to enter and leave the dock at almost any state of the tide. Hitherto ingress and egress has had to be effected through adjacent entrances which only permitted of arrival and departure within a period of 3 hours, viz 1½ hours before to 1½ hours after high water, involving outside those time limits, temporary berthage for the excluded craft alongside the Prince's Landing Stage, where, in addition to passenger traffic, cargo had sometimes to be dealt with, causing congestion and occupying frontage required for other vessels.

The lock will consist of two sections, or compartments, 315-ft. and 135-ft. long respectively. Set at an acute angle to the river, the entrance is intended to be negotiable without the aid of tugs. A vessel arriving with the flood tide will turn in the river and align herself along the eastern lock wall extension, where there will be freedom from the eddies and currents which caused so much trouble and inconvenience with the older entrances. Alternatively, arriving on the ebb tide, a vessel should be able to make up to the same wall without difficulty, to lie there until such time as she is ready to enter the dock.

of the internal arrangements of the central docks, including the provision of suitable turning space. The passage and bridge between the Victoria Dock and the West Waterloo Dock are to be removed and the bridge will be re-erected at the north-west corner of the Victoria Dock over a new passage to be constructed there, giving access to the west side of the Trafalgar Dock.

The loss of a berth on the west side of the West Waterloo Dock will be compensated by converting the Prince's Graving Dock into a wet dock. Later, an additional berth may be provided in the Princes Half-Tide Dock by the construction of a quay wall in the position shown by the dotted line on the plan, across two of the existing entrances.

The scheme is of considerable importance to one Liverpool shipping firm: Coast Lines, Ltd., who, after the completion of the undertaking, will be enabled to maintain their Liverpool and Ireland service with a smaller number of vessels. Formerly, when a vessel missed the tide, a delay of 10 hours was incurred, but under the new facilities, no such delay should be experienced, so that the size of the fleet may be reduced without detriment and this reduction will relieve the Dock Board of the necessity of providing intermittent accommodation for the service at the Prince's Landing Stage.

The total estimated cost of the scheme is £732,000.

# *Port Marghera*

## *The Industrial Port of Venice*

The following is a translation of the text of a recent radio talk from Rome by Prof. Dr. Ing. Enrico Coen Cagli, M.Inst.C.E., on the present situation in the development of the new industrial port (Porto Marghera) at Venice. For the photographic illustrations we are indebted to Prof. Coen Cagli.

Porto Maghera, the notable undertaking rising on the border of the Venetian Lagoon, on a site where a few years ago there was only a deserted marshy waste infested with malaria, initiated while the European War was still raging, conceived in a spirit of foresight not only as regards victory, but for the new era which would follow the victory—and which to Italy would disclose the remarkable discovery awakened and conducted by the providential Man who for fifteen years has guided its destinies—constitutes to-day in the renovated Imperial Italy one of the most powerful and efficient organisations of the Italian economical structure.

It is the happy solution finally given to one of the greatest and most complex problems, jointly of local and national interest, which for long years was under discussion before the outbreak of the conflagration.

### The Development of Venice

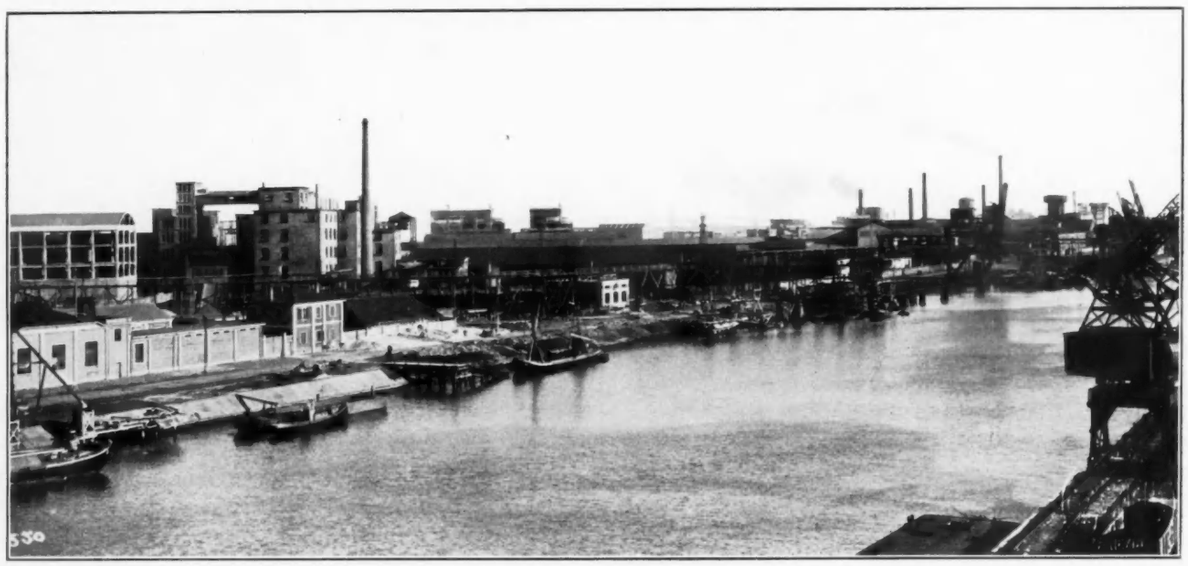
Initially, the problem arose having for sole object the enlargement of the old mercantile harbour of Venice; the so-called Maritime Station, which, confined to the extreme western border of the city, had from its origin and at every successive stage in its formation demonstrated how, in the very narrowness of the port accommodation, the traffic would find an insuperable obstacle to its natural development. Moreover, in addition to local limitations, the problem was bristling with difficulties, imposing with absolute rigour the threefold condition that the new works, designed with a broad vision of future needs, should not ever be able in the progress of their extension, dangerously to alter the delicate regimen of the lagoon waters, nor to cause offence to the monumental and artistic character of the city, nor to minimise in any way the outstanding framework of its incomparable beauty.

But if there was a real intention to re-open to the venerable Queen of the Sea the path to a future worthy of its glorious past, and with its renaissance to secure likewise for the country a new powerful instrument of economic development—which Venice, by reason of its favourable geographical position, could and should constitute—not only was it necessary to give to the problem of the progressive extension of the maritime landing-place an adequate solution, outside of every limitation imposed by suggestions, whether hydraulic or artistic or æsthetic; but it was necessary that two other problems should be considered in the simultaneous result. It was necessary that alongside the new commercial harbour should arise a great industrial centre and that in connection with each of them there should be provided a new urban quarter, adequate for new needs and suited as a whole to admit of that building and demographic expansion that for too long hitherto had been found intolerably repressed within the narrow, insuperable confines of the old city.

Among the vast array of projects turn by turn presented and rejected, an idea, different from all the rest and sufficient to solve in a satisfactory manner the port problem, has been certainly confronted right from the beginning of the investigation, viz., that of creating a new landing place on the edge of the lagoon on the mainland. But against this solution—which had only succeeded in gaining a beginning of realisation when it was cut off by the outbreak of the War—arose and persisted the opposition of institutions, associations and private citizens, who in the solution itself, believed that they recognised the most serious menaces to local public and private interests.

### The Antecedents of the Port

Nevertheless, it was evident that in the large expanse of pools and of uncultivated low-lying lands extending to the margin of the lagoon, no further distant than 4 km. from the old city, near the great road and railway network of Mestre, not only the enlargement of the commercial port, but the entire treble problem, portual, industrial and housing, would be able to find its most complete and happy solution. It appeared then that to realise the great design in spite of every ill-considered opposition, one only way presented itself, viz., that of a private association, composed of some among the greatest exponents of Venetian industry and commerce, which might obtain—with express renunciation of every intention of private speculation—a concession for the mainland works, assuming all the risks and all the responsibility.



Photo] *Frontage of the North Industrial Canal.* Giacomelli, Venice

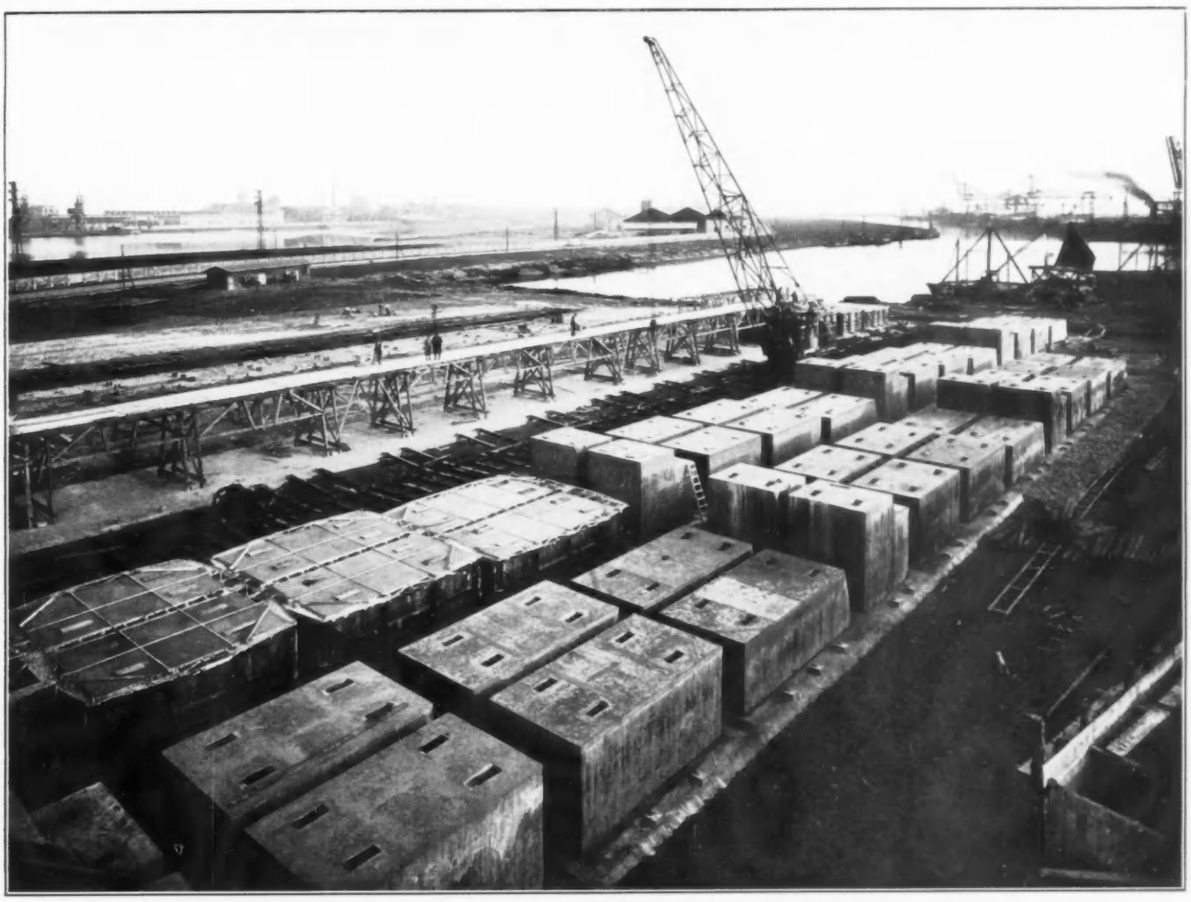
It was thus that in 1917, during the full tide of war, the Industrial Port of Venice Company, constituted by a group of citizens rallied round a great Venetian, Count Joseph Volpi, sought and obtained from the Government with its full agreement, primarily in association with the community of Venetia, the concession for the undertaking of Port Marghera, regulated by rules particularly designed with special economic and fiscal facilities to favour the most rapid creation of the desired great industrial centre. And forthwith was undertaken the realisation of the scheme, now assured within wider limits, with immediate full comprehension of its high ends at the advent of the new regime.

### The Industrial Zone.

Connected to the old landing-place and to the old city by a waterway with a deep water channel, opened across the Lagoon, starting from the basins of the Maritime Station and by way of the site of the New Littorio Bridge and linked on the other hand by suitable works with the important network of waterways which concentrate on the central basin of the Lagoon, the territory of Port Marghera extends over an area—susceptible of further expansion without practical limits—of some 2,100 hectares (say 5,000 acres) of which 600 hectares (1,440 acres) are assigned to the new commercial port 1,300 (3,120 acres) to the industrial port properly so-called and 200 (480 acres) to the new housing district.

Of the new commercial port there is up to the present in commission a first operating basin, bordered by 1,700 metres (5,500-ft.) of quay berthage for large cargo vessels, sufficient in fact with the aid of a plentiful equipment of mechanical plant and rail tracks to double in the normal course of operation, the potentialities of the mercantile Port of Venice.

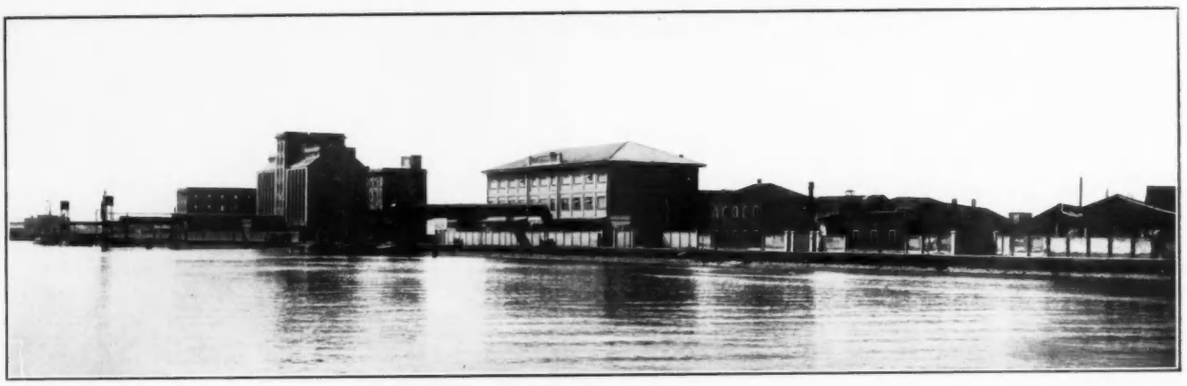
# *Port Marghera*



Photo] *Block Making and Setting at Commercial Basin, No. 1.* Giacomelli, Venice

Photo] *Filling behind Quay Wall, Commercial Basin, No. 1.* Giacomelli, Venice

## *Port Marghera—continued*



Photo] *West Industrial Canal Front.* Giacomelli, Venice

In the industrial zone at present systematised over an extension of 600 hectares (1,440 acres) of solid ground, intersected by 7 km. (4⅓ miles) of wide and deep canals, with 16,000 metres (4,880-ft.) of frontage suitable for berthage of craft, served by fitting network of roads and by 25 km. (15½ miles) of railway track connecting the individual establishments with the station at Mestre, there are now erected 85 factories, while another 5 are in hand, occupying altogether 385 hectares (924 acres), with 500,000 sq. metres (598,006 sq. yds.) of covered area; while adjoining the Zone has rapidly risen and goes on developing in the form of a garden city, the new urban quarter, which already affords healthy and agreeable abodes for about 8,000 inhabitants.

The comprehensive district thus prepared has been provided by the Commune of Venice with all the necessary equipment and services for public use, among which may be enumerated 46 kilometres (28½ miles) of excellent roads, brilliantly lighted, 30 kilometres (18½ miles) of sewers, an aqueduct for portable water supply and another for industrial use, capable of distributing, respective, 22,000 and 90,000 cu. metres (5,000,000 gallons and 20,000,000 gallons) of water daily.

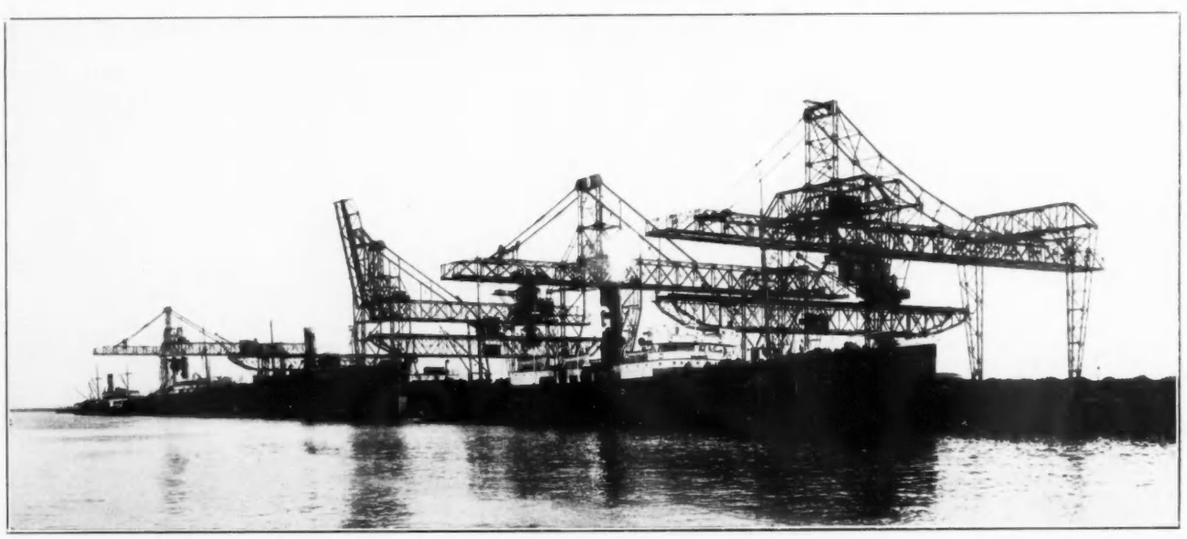
### Imposing Factories

Forming part of the imposing industrial installation up to the present are 22 factories of primary essential importance in the national economy, comprising a group of establishments for the manipulation and treatment of mineral oils with an assemblage of reservoirs of capacity exceeding 450,000 cu. metres (588,593 cu. yds.); a manufactory of glass and crystals capable of furnishing annually three-fourths of the total national requirements in sheets; a manufactory of metallurgical coke capable of producing 1,500 tons daily; a manufactory of fertilisers for the annual output of a million quintals of phosphates and an annexe fitted for the production of sulphuric acid and for the extraction of ferric minerals from pyrites ashes; three establishments for the extraction of alumina; an aluminium factory and a zinc factory, both in process of enlargement to double their output; a vast array of factories for the manipulation of light alloys; a calcium carbide factory; a large electrical steel works with an annexe for iron sheeting and metal framing; a naval shipyard with mechanical and fitment laboratory; a refractory work shop; an oil refinery; a flour mill and an establishment for rice polishing; to which may be added as reserve plant for electrical energy production, a steam electric generating station of 100,000 horse power.

Such a conglomeration of large workshops with the other 63 factories actually at full efficiency appertaining to medium and small industries for the production of manufactures of the most varied kinds has during the past year assured daily occupation to 13,000 workmen and 750 staff, remunerated by a total of salaries and wages of 62 million lire, and has given rise in the industrial port alone to a global movement of material, raw and manufactured, of over 2,800,000 tons, of which 1,700,000 tons were shipped to sea, 820,000 tons moved by rail and about 300,000 tons transported by ordinary road traffic and by river navigation.

The total amount of capital invested to date in the creation of Port Marghera in its three separate sections—the new commercial port, the industrial port, and the urban district—reaches a little less than a milliard-and-a-half of lire of which not more than 200 million is at the charge of the State for the works essentially for the port and navigation; 80 millions at the charge of the Commune of Venezia for public works within its competency; 13½ million granted by the Autonomous Institute for Popular Housing and a good 1,150 millions, about, of private funds invested in industrial concerns and the relative auxiliary plant.

Such are the origins, the leading features and the development attained up till now by the grandiose work, not unworthy of the triumphal progress of Mussolinian Italy; work conceived, promoted and conducted with passion equal to the faith which had inspired it and which, protecting fully the security of the Lagoon, as well as the monumental and artistic integrity and the incomparable beauty of the divine city, has assured to Venice a vigorous source of flourishing economical life and to Italy a potent instrument for prosperity and working activity.



Photo] *Coal Handling Plant, Commercial Basin, No. 1.* Giacomelli, Venice

# *Destruction of Timber by Marine Organisms in the Port of Sydney*

## *Excerpts from Supplementary Report No. 1*

*By R. A. JOHNSON, F. A. McNEILL and TOM IREDALE*

*(continued from page 291)*

### Crustacean Desertion Habit

In various instances it has been established that the surface-attacking crustaceans " Limnoria " and " Chelura " desert their workings in timber samples when the interior of the wood has reached an advanced stage of absorption through Cobra infestation. This will sometimes happen when only a minor surface attack by the crustacean borers is present, and they have met with the bore holes by a previously established maximum internal attack by Cobra at a shallow depth. Always the form " Chelura " is first to desert in the above circumstances. Such observations bear out those of overseas authorities who claim a wood fibre diet for the pests in question, because in the circumstances the borers obviously show no further inclination to occupy workings which are still intact and offer adequate natural protection. An ample illustration of the conditions here described is to be found in the records of the May and October samples observed at Station 32 (Manly) under dates of examination 20th February, 1933, and 22nd March, 1933, respectively.

*A portion of oregon timber heavily infested with Cobra, and clearly showing the natural aversion of the borers to cross even the closest fitting seasonal checks or splits. In the present example the timber has been opened at such a place to display the surfaces unblemished by the numerous borers which worked so close to them.*

### Chelura—Some Peculiarities

Since the inception of the marine borer investigations in Port Jackson, it has become increasingly evident that " Chelura " is not a menace to hardwoods. Only in very isolated cases has it been found associating in a secondary capacity with "Limnoria" in hardwood destruction, but never in turpentine. The reason for such behaviour is considered to be directly due to the size and shape of " Chelura," and not to a difference in boring ability. Hardwood provides greater resistance than softwood against crustacean attack, and while the tiny flattened form of " Limnoria " may quickly burrow its way to a safe depth, " Chelura," under the same circumstances, would normally remain too long exposed to molestation from predatory enemies.

### Cobra Survival and Food Supply

A study of the subsequent observation details of timber re-actions to borer attacks in this report, shows that control test samples badly infested by Cobra were retained after reaching a stage of destruction assessed at 100 per cent. The reason for this was to ascertain just how long the Cobra animals would survive under conditions where inadequate timber fibre remained.

Several authorities have claimed that sustenance is obtained by Cobra from the timber fibre it bores. It would seem that these claims are borne out by conclusions arrived at from the recent experiments, which indicate that invariably a marked mortality is evident soon after a test sample reaches a stage of destruction accepted as 100 per cent., when no further timber fibre remains to be absorbed. A further fact gleaned was that the life span of Cobra is governed by the period during which it is able to indulge in active boring operations. While it has been established that there is a restricted period of life after active boring operations have ceased, no local evidence is available which would indicate the life span of any Cobra animal under unrestricted boring conditions; i.e., where unlimited unabsorbed timber is available. The field of present observations in Port Jackson covers only the reaction of standardised timber samples, which under attack ultimately become reduced to a state when practically no unabsorbed timber fibre remains (100 per cent. destruction). Under such conditions it can be readily established that Cobra survive for a maximum average of approximately 9.5 months following the date of lodgment. A period of approximately six months was covered from the time when all accessible wood fibre had been consumed, which was judged from the time when the damage to a control test sample by Cobra had been assessed as at the 100 per cent. stage. The recent experiments have proved that, following this stage, mortality is accelerated during the warmest three months of the year. The foregoing remarks, covering the results obtained from the most recent work, considerably amplify the quotation appearing on p. 29 of the initial report, which reads as follows: " Shipworms, after they have excavated a comfortable home, and lined this to a varying degree . . . with a smoothly shelly deposit, eventually stop burrowing, but continue to live and feast and reproduce, no one really knows for how long a period."

In order that Cobra borers may become well established and develop quickly in an attack, it is necessary that the larvæ should have ideal conditions for lodgment and development. Therefore a timber unimpaired by the intensive surface attacks of crustaceans provides an easy and uninterrupted entry to the interior. On the other hand, larvæ which may chance to lodge in the fretted maze of extensive and deep-cut crustacean borings cannot survive long enough to develop and force their way beyond the range of the crustacean operations without being virtually eaten out along with the quickly destroyed timber fibres. A splendid example bearing out this contention is to be had in the observation details of the April Sample (Manly). At Manly, Cobra attack is normally predominant, but during the month quoted crustacean borers became intensively established when Cobra activity had become quiescent with the onset of the colder weather.

### Bankia Occurrence

During the most recent period of the investigations several facts were established, which it is felt should be given prominence as introductory remarks to the succeeding observation details. In this regard the Cobra forms of the genus "Bankia" noticeably occurred more abundantly at a higher level on the control test samples. They were not, however, more numerous than the species of " Teredo," which were found distributed more uniformly along the length of the samples. After a sample has been a few minutes out of the water, the " Bankia " animals will betray their presence and numerical strength by the prominent extrusion of their long tapered pallets. Because of this, emphasis is given to the presence and number of " Bankia " pallets found extruded from samples during examination.

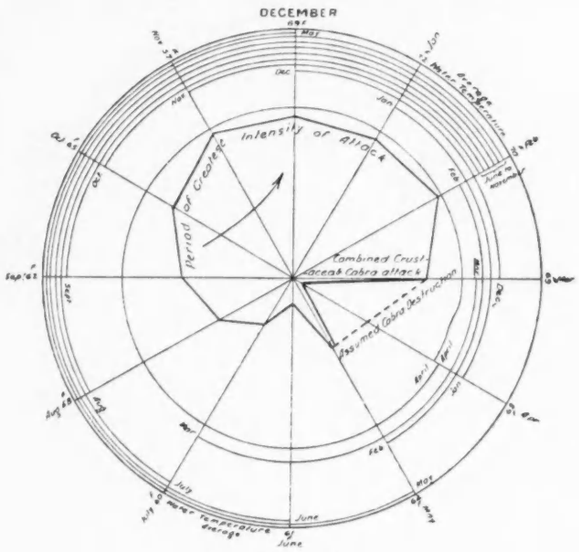
### Cobra Breeding

In the initial report it was stated that the Cobra breed probably twice a year in Port Jackson—in the spring and in the autumn. The most recent observations, however, prove that these molluscs breed throughout the year, the most intensive period being during the months November to February. (See Peak of Destruction Graph). Naturally, the Cobra animals have to survive during the rigours of the winter season, when only sparse infestation has been detected in the control

## *Destruction of Timber by Marine Organisms—continued*

test samples. There is ample evidence that as the unfavourable period of lowered water temperatures arrives, only relatively few of the autumn broods survive. Nevertheless, these are sufficient to perpetuate the breeding, which appears to reach its minimum period of intensity in the months July to October. After this period, a greater percentage of newly-lodged larvæ has been found to prosper. By the time November is reached a superabundance of larvæ are available for development and active work under increasingly favourable conditions.

Station N°32 Manly
Showing Annual Peak of Destruction by Borers 1932-33-34.
Preponderance of Attack by Cobra Borers.




### Larval Diversity

While dealing with the breeding of Cobra, it is necessary to state that not all of the larvæ of Port Jackson forms are extruded as complete minute bivalves, as noted on p. 27 of the initial report (1932). This procedure applies only to the species "Teredo pertingens" and "T. shawi," and possibly "T. balatro." In these forms a free-swimming stage of larval development and metamorphosis is suppressed. Thus the early changes in larval character take place internally within the gill chamber of the parent, and the minute bivalves finally released are fully equipped quickly to effect lodgment and embark on their operations as boring organisms. In "T. pertingens" bivalve larvæ have been observed in animals only three-eighths of an inch in length and three-thirty-seconds of an inch in diameter, indicating an age of approximately six weeks from time of lodgment, based on the observation that local Cobra enlarge their bore holes diametrically during earlier periods of uninterrupted growth at the rate of approximately one-sixteenth of an inch per month in softwood.

As with those forms producing bivalve larvæ, fertilisation of "Teredo austini," the species of "Bankia" and other Cobra in Port Jackson not previously enumerated, is also believed to take place internally. In this way the floating sperm, freed through the exhalant siphon of the male, is drawn in through the inhalant siphon of the female to penetrate the ovum and cause the release of a miscroscopic larvæ, which may float and swim in the water for a week or slightly longer period before finally changing to the bivalve stage and effecting lodgment. In the last-named forms of Cobra a common condition met with is the occurrence of either a creamy coloured mass or an extensive white milky state of the body indicating an advanced phase of the development of the sex products.

Over a period of years and during all seasons internal bivalve larvæ have been closely and fruitlessly searched for in Port Jackson, Cobra other than "Teredo pertingens," "T. shawi" and "T. balatro."

### Nausitora in New South Wales

At the time of the publication of the initial report of the present investigations, specimens of the Cobra form, now known as "Nausitora messeli," were recorded from the general locality of Port Jackson, collected many years earlier by Charles Hedley. No fresh examples from the same locality had come under notice during the lengthy period of the investigations preceding the publication in 1932. The only additional material of the species obtained and recorded at the time was from the tide-influenced fresh water of Cattai Creek, Hawkesbury River watershed, New South Wales. Another "Nausitora" has been met with in similar circumstances in the upper reaches of the Brisbane River, Queensland, where it ranges down stream in varying strength of occurrence into water with a salinity not higher than approximately ten parts per thousand.

The most recent local investigations have verified the occurrence of "N. messeli" in Port Jackson waters. Many examples have been observed and collected by R. A. Johnson in the upper waters of Middle Harbour, three miles above Roseville bridge, and one specimen was taken from the upper Lane Cove River, about six miles above Figtree Bridge. Also, under similar circumstances, the upper reaches of George River, flowing into Botany Bay, New South Wales, have yielded a most intensive infestation of "N. messeli" comparable with the attack by its close relative in the low salinity waters of the Brisbane River, Queensland. The salinity readings for these three New South Wales localities average to date 12 grammes per kilo., 15 grammes per kilo., and 1.5 grammes per kilo. respectively. An understanding of these readings makes clear the reason why the form "Nausitora" is not found in the high salinity or open waters of Port Jackson. At a later date, it is intended to arrange for a control station in George River on the same principle as the stations at present organised for observation of the annual cycles of attack in Port Jackson.

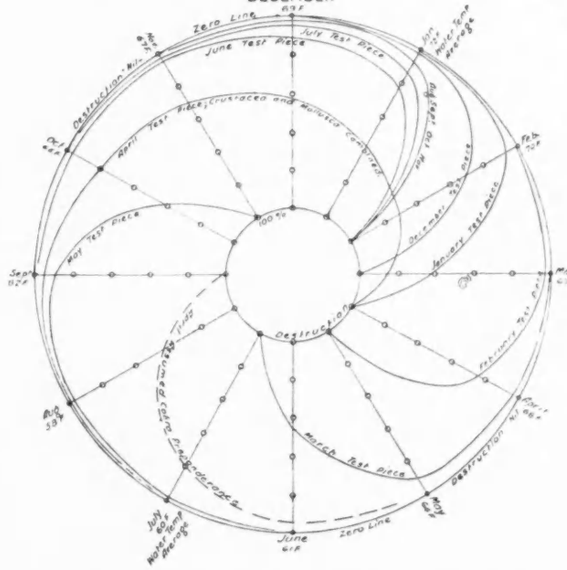
### Marine Growths and their Effect

The types of growth met with on the timber samples at the stations under present review were generally the same as those described on p. 131 of the initial report (1932), and it was not considered necessary to do more than refer to most of them by name in the present work. As before, occurrence was seasonal and spasmodic, but nevertheless, it was thought worth while to preserve continuous records.

Seaweeds should tend to baffle larval Cobra lodgment at some periods of their growth. Barnacles, Bryozoa, tunicates and mussels, when alive, would consume great quantities of larvæ as part of their planktonic diet. The barnacles additionally provide calcareous basal plates, which so closely adhere to timber after the remainder of the shell components of each individual have become detached, that they prevent outside penetration into the areas they cover.

Sometimes also the thin, brittle, calcareous growths of encrusting Bryozoa provide a temporary covering, which appears to assist the operations of "Limnoria" during the initial stages of that borer's attack on surface timber fibres. And, on the other hand, the denser, fleshy, compound tunicate growths can, under the same circumstances, temporarily slow down an attack by "Limnoria." This is better understood when it is known that compound encrusting tunicates have commonly been observed to establish themselves and completely cover a timber test piece in the short period of three weeks. With the advance in intensity of "Limnoria" and "Chelura" attacks, the borers readily undermine and destroy the anchorages of both simple and compound encrusting tunicates, so that they fall from the surface of the timber. Subsequent new tunicate attachments may occur, but these enjoy only a precarious foothold, and quickly go the way of their predecessors.

Station N°32 Manly
Progress of destruction of 12 Oregon samples set at Monthly intervals and used for determination of annual cycle of attack.
Preponderance of Attack by Cobra Borers.

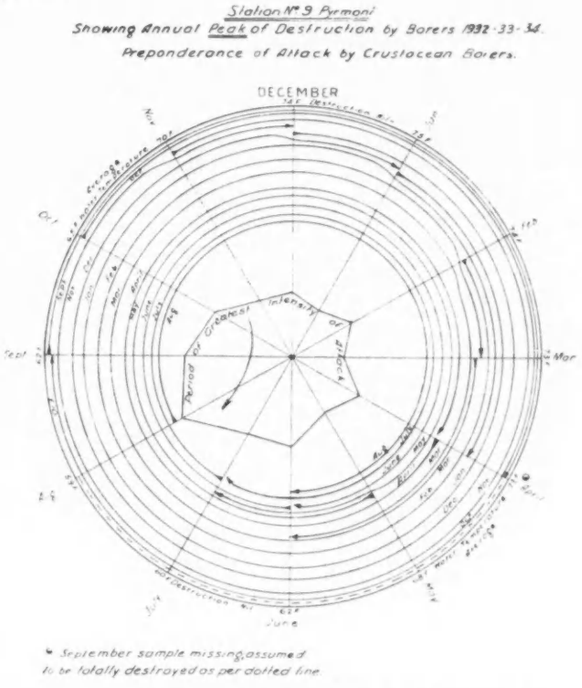



The radius lines are divided into intervals, each of which has a value of 20%.

Notwithstanding the obvious attributes of marine growths, however, they have proved not generally to be a reliable preventive against larval lodgment and excessive destruction. This is borne out by the conditions existing at Station 31 (The Spit,

## *Destruction of Timber by Marine Organisms—continued*

Middle Harbour), where there is a narrow tidal rip running into an extensive broadwater. At this site a concentration of floating life occurs, and the period for lodgment of both marine growths and the larvæ of the abundant Cobra infestation coincide. The former develop to abnormal proportions, and the latter causes rapid destruction to timber samples. As a consequence, there is not a full materialisation of the protective advantages which might be expected from the presence of abnormal marine growths.


Station No 9 Pyrmont
Showing Annual Peak of Destruction by Borers 1932-33-34.
Preponderance of Attack by Crustacean Borers.
DECEMBER
Period of Greatest Intensity of Attack
June

* September sample missing, assumed to be totally destroyed as per dotted line

### Summary of Matter in " Destruction of Timber by Marine Organisms in the Port of Sydney, 1932."*

The study of marine borers and their depredations was placed on a systematic basis for the first time in Australasia.

Results from experiments carried out over a period of three years at thirty-seven testing stations were presented, with the incidence of marine borer attacks at each carefully recorded and published in tabulated form.

Specially prepared graphs of attack intensities and water conditions were prepared for each testing station in order to assist the reader in interpreting the data collected.

A systematic account of the Cobra borers and an article on their crustacean associates appeared, both fully illustrated.

Attacks by Cobra borers were proved to be carried out by many different species, all of which were hitherto undescribed.

Certain localities in the Port were found to be decidedly less affected than others by the depredations of marine borers, and thus was opened up a further interesting field of inquiry in the determination of governing factors responsible for these differences.

Specific differences of attack for the inter-tidal zone and the area below low-water mark were determined, and data gathered for the execution of practical measures of preservation.

A way was shown for the effective treatment of damaged piles by the use of direct cement casings, which were employed as an initial step in preservation methods, as opposed to costly replacements.

Attention was drawn to various modes of attack, and in this regard the most vulnerable points of entry into timber were indicated.

The paramount importance of turpentine as a piling timber in the Port of Sydney was verified, and emphasis laid on the necessity for retaining its bark in an undamaged state as a protection against borer attacks.

Comparisons were drawn between conditions of marine borers in Sydney and Brisbane waters, a procedure not previously attempted for any two Australian ports.

A most complete review of marine growths likely to be found on piles was prepared, and a table drawn up to show occurrences at various seasons of the year.

### Brief Outline of the Scope and Results of the Present Report

The study of the depredations of marine boring pests in the Port of Sydney has been advanced another stage with the inauguration of a series of Control Test Stations for the determination of Annual Cycles of Attack. With the present published results some very definite and reliable evidence is made available, defining the seasonal periods of the year when the pests are most destructive, and thus indicating the times when the employment of preventive measures is most effective and economical.

Full records from two station sites at opposite ends of the Port are presented. Coupled with the compact graph illustrations, a very striking contrast of attacks has been recorded.

Investigation has established that the virile Cobra form " Nausitora " is confined solely to the low salinity waters of the upper river and harbour reaches of the Port. Thus it does not, at present, constitute a menace as was suspected on the evidence suggested by the previously unique specimen collected by Chas. Hedley, and bearing the general locality " Port Jackson " (Port of Sydney).

Through the institution of Annual Cycle of Attack tests it can now be said that evidence is forthcoming relating to the fluctuations of Cobra larvæ, which provide the reason for changed progress of attacks.

It has been established, after intensive observations, that the sapwood of turpentine piles does not present within measure the resistance proved for the truewood of the same timber; this has a special significance in cases where sawn material is used in any part of submerged marine structures.

Following the identification of Nereid worms as scavengers, some thread-like Nemertine worms and leaf-shaped Planarian worms have been similarly recognised. No direct evidence is available, however, to prove that the scavengers in question are responsible for any mortality among Cobra borers.

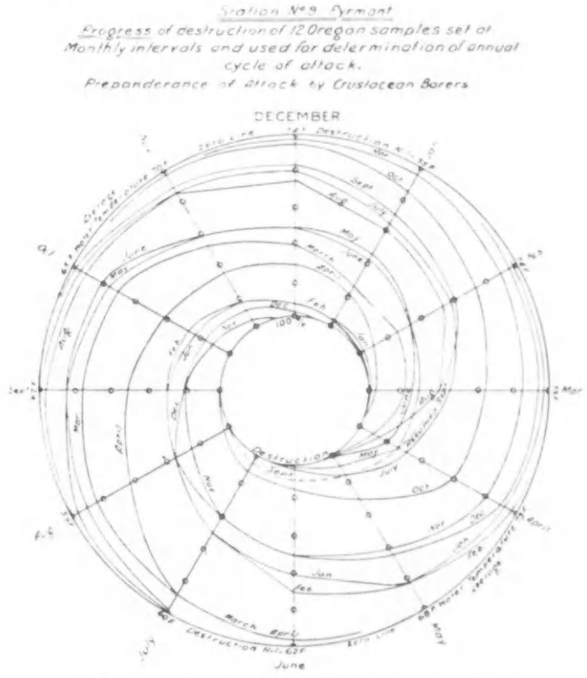
As a result of the close inspection of the control test samples of Oregon fir in the present series of experiments, it has been established that Cobra borers survive for approximately six months after reaching a stage when no further possible nutriment could be obtained from the timber.

Claims made respecting the partial sustenance of Cobra from the timber fibre consumed are strengthened by the recent series of observations.

The more critical methods and inspection of control test samples adopted have enabled the determination of a record time (two months, exclusive of the initiation period of attack) for the destruction of standard test samples of timber by Cobra in the Port of Sydney, and possibly for the world.

Further evidence has been advanced concerning the marked destruction of " Sphæroma " in the Port.

" Chelura," invariably an associate of " Limnoria " in soft-wood, need not be considered a factor in the destruction of the hardwoods at present in use.


Station No 9 Pyrmont
Progress of destruction of 12 Oregon samples set at Monthly intervals and used for determination of annual cycle of attack.
Preponderance of Attack by Crustacean Borers
DECEMBER
June

The radius lines are divided into intervals, each of which has a value of 20%

As already established for numerous marine creatures in temperate and tropic seas, Cobra in the Port of Sydney have been observed to breed throughout the year, but there is new evidence of one intensive breeding season during the warmest months of the year.

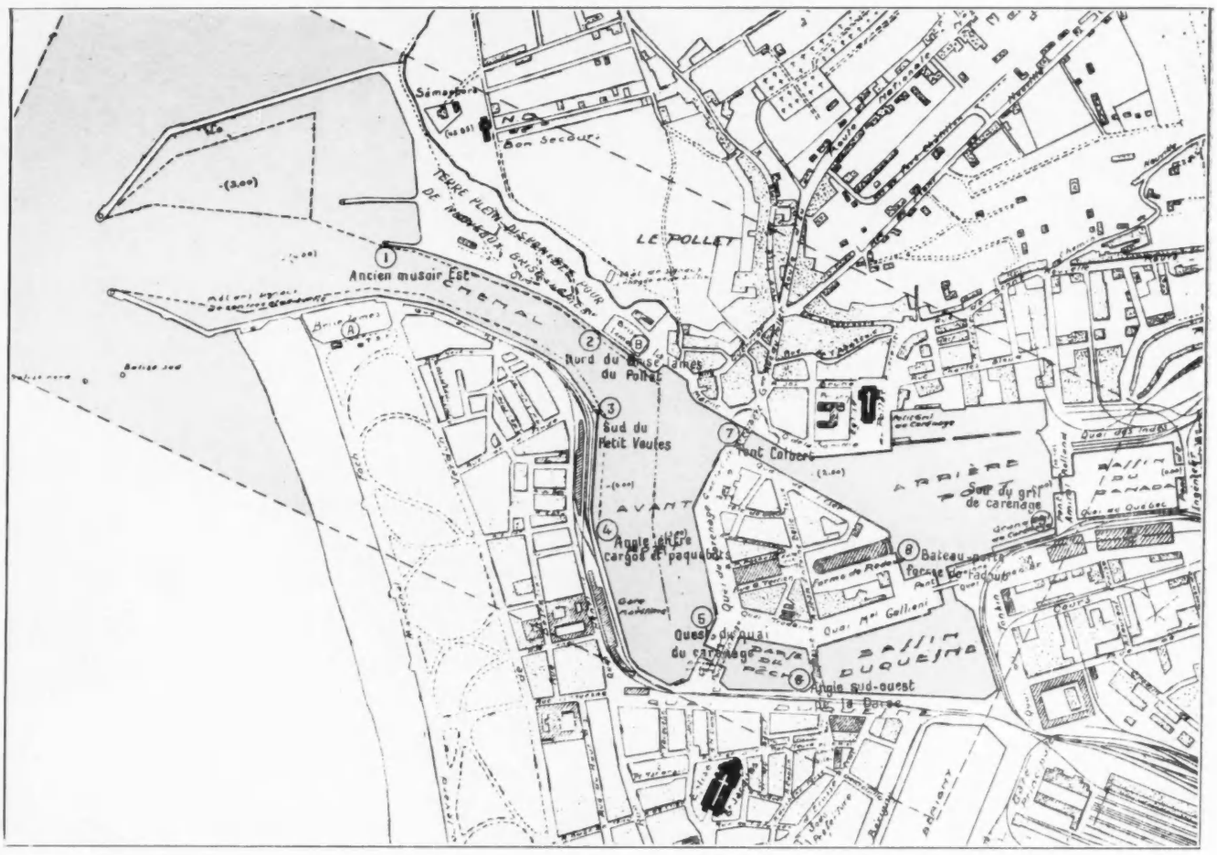
Notwithstanding the amount of additional data concerning marine growths in association with borer-attacked timber, a definite value cannot yet be claimed for them as reliable palliatives.

*Referred to in this article as the initial report.

# *Proposed Wave-traps at Dieppe*

## *Experiments with Models*

*By M. PÉTRY, Ingénieur des Ponts and Chaussées.*




*Plan of the Port of Dieppe.*

### I.—Object of the Scheme

THE PORT OF DIEPPE is protected on the seaward side by two converging jetties, built between 1905 and 1914; the swell fans out as it enters and waves break on a spending beach of sand and shingle. Nevertheless, in stormy weather, disturbance does take place not only in the entrance channel and outer harbour, but even within the fishing harbour and inner harbour, especially at high water; ships are tossed against the quays and the lock gates chatter.

Before the construction of the converging jetties, the harbour works at Dieppe included two wave-traps which are still in use; one of them, with an area of 7,200 square metres, lying to the north-west of the entrance channel; the other, of 2,500 square metres, at the place called "Le Pollet," opposite the outer basin. See Plan A and B.

Although they are not major works, these traps are efficient and reduce appreciably the surge in the channel and the basins of the harbour. It is this beneficial effect which gave rise to the idea of creating a further number of them on the east of the channel in order to reduce the disturbance still more.

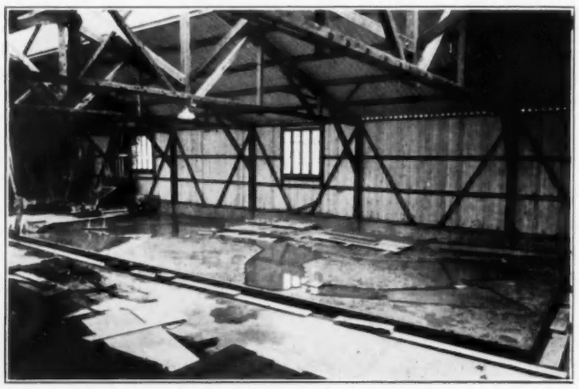
Experiments with a model were decided upon with a double object: to determine the best form for the wave-breakers to take and to find in what proportion the surge could be reduced.

### II.—Description of Apparatus

In one of the dock sheds a model has been made of the area indicated on the plan which comprises the whole of the water surfaces subject to tidal variation, including the Duquesne Dock, of which the opening into the outer harbour is envisaged.

Made to a scale of 1.100, the model is 17 m. long, 7 m. wide, and 20 cm. high.

The jetties, quay-walls and wave-breakers are formed of wood. The bottom is modelled in damp sand, covered with cement mortar, representing in relief the contours as surveyed in the summer of 1934. The solid-fill reclamation is in sand and the beach in fine shingle. The model is filled with fresh water up to the level of mean high tide.



*View of model.*

*Single wave-trap to the North of the old one at Le Pollet.*

## *Proposed Wave-traps at Dieppe—continued*

*The existing wave-trap at Le Pollet and three new ones of the same type.*

*Three Triangular Wave-traps.*

On the east of the channel, removeable panels represent either the present wall, or the various kinds of wave-breaker contemplated, whether in the form of a single unit or three, and in the latter case whether of the Pollet type, or trapezoidal, or triangular.

The photographs taken against the light, in four of the views reproduced in this article, show that the swell propagated along the axis of the channel and normal to it swings round nearly 90 degrees on to the single wave-breaker, but does not break much upon it. It swings about 45 degrees on to the Pollet type breakers and breaks in their south-east angles. It swings about 30 degrees on to the trapezoidal and triangular breakers and breaks along nearly the whole of their length.

To propagate the swell, a wedge-shaped displacer is made up of four boards, weighted with sand, and is mounted on a horizontal pivot, balanced by a counterweight and actuated by a rod connected to an eccentric pinion on a flywheel with a handle. The displacer oscillates vertically when the handle is turned. Adjustment of the amount of eccentricity enables the amplitude of the waves produced to be controlled. The operator turns the handle in time with the beats of a metronome, so that the period or rhythm may be varied at will, without the regularity of movement being dependent upon the personal factor. In fact the time period is found experimentally as that by which waves of the desired length are produced; for a natural swell can be represented to scale in the model, in respect of wave-length and amplitude, but the speed of propagation cannot be thus determined.

Outside the jetties, the swell impinging on the brick dwarf walls enclosing the model produces a **clapotis** or standing wave. Within the jetties and in the entrance channel, the swell travels with great regularity in one direction and breaks upon the wave-traps or breakers; though it does so to a smaller extent than in the actual harbour; which is doubtless due to the fact that the surface tension of the water, being much greater in proportion in the small-scale model, restrains the breaking of the waves. At the inner end of the harbour the movement is sometimes exaggerated in the model by resonance.

*Three wave-traps of trapezoidal shape.*

The effects of the surge in the harbour are observed at different points, numbered 1 to 9 on the plan. As the movements are often only of a few millimetres, they are difficult to observe by direct reading. It has, therefore, been necessary to employ an amplifying device, consisting of a ball of celluloid attached to a cranked lever. The floating ball rises and falls with the water and moves the short arm of the lever: the other arm, three times as long, at its upper extremity moves across a graduated scale, each division of which corresponds to one millimetre range of the surge in the model and to 10 centimetres (4-in.) in the harbour.

*Amplifier.*

A model ship, to the same scale as the harbour model, gives an indication of the effects of pitching and rolling due to the swell.

### III.—Characteristics of the Varieties of Swell Studied.

It is from the west and north-west that come the most frequent and the strongest wave swells and it is these that have been particularly studied.

The model, as has been seen, has all its dimensions to the scale:

$$\alpha = \frac{1}{100}$$

The time period of waves is related to the wave-length by the ratio:

$$2\,T = K \sqrt{2\,L}$$

If the scale of time is denoted by $\beta$, then:

$$\beta = \sqrt{\alpha} = \frac{1}{10}$$

The scale of velocities is then:

$$S = \frac{\alpha}{\beta} = \sqrt{\alpha} = \frac{1}{10}$$

which the model confirms.

The wave-swells experimented with have been as below:—

| | | Natural Characteristics | Characteristics in the Model |
|---|---|---|---|
| Hurricane ... | Wave-length ... | 60m. | 60cm. |
| | Amplitude... ... | 4m. | 4cm. |
| | Period ... ... | 7.5 sec. | 0.75 sec. |
| Average Storm ... | Wave-length ... | 30m. | 30cm. |
| | Amplitude... ... | 2m. | 2cm. |
| | Period ... ... | 6 sec. | 0.6 sec. |

Waves from the east have also been represented.

## *Proposed Wave-traps at Dieppe—continued*

TABULATED RESULTS OF EXPERIMENTS ON 13th AND 25th MAY AND 10th AND 19th JUNE 1936.

| | | | | North Channel | | | Outer Harbour | | Fish Dock | South Channel | Inner Harbour | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Water Level M. | | | Old East Pier. | North of Le Pollet Wave-trap. | South of Petit Veules | Angle between Cargo and Passenger Berths. | West of Repairing Quay. | South-West Corner of Fish Dock. | Colbert Bridge. | Floating Caisson Gate of Dry Dock. | South end of Gridiron | Observations |
| Waves from West | 7.50 to 8.00 | Height 2m. Wave Length 30m. Period 6sec | A | 0.50 | 0.40 | | 0.30 | 0.10 | 0.10 | 0.20 | 0.05 | 0.05 | |
| | | | B | 0.50 | 0.10 | | 0.20 | 0.10 | 0.05 | 0.10 | 0.05 | 0.05' | |
| | | | C | 0.50 | 0.05 | | 0.10 | 0.10 | 0.02 | 0.05 | 0.01 | 0.01 | |
| | | | E | 0.50 | 0.05 | | 0.05 | 0.10 | 0.02 | 0.05 | 0.00 | 0.01 | |
| Waves from N.W. | 8.00 to 9.00 | Height 4m. Wave Length 60m. Period 7.5sec. | A | 1.20 | 0.80 | 0.60 | 0.40 | 0.25 | 0.10 | 0.60 | 0.15 | 0.05 | |
| | | | B | 1.20 | 0.40 | 0.40 | 0.30 | 0.20 | 0.10 | 0.20 | 0.05 | 0.20 | |
| | | | C | 1.20 | 0.40 | 0.50 | 0.40 | 0.40 | 0.10 | 0.30 | 0.10 | 0.20 | |
| | | | D | 1.20 | 0.30 | 0.30 | 0.20 | 0.15 | 0.10 | 0.25 | 0.10 | 0.10 | |
| | | | E | 1.20 | 0.30 | 0.40 | 0.20 | 0.10 | 0.05 | 0.20 | 0.00 | 0.05 | |
| | 7.50 to 8.00 | Height 2m. Wave Length 30m. Period 6sec | A | 0.90 | 0.70 | | 0.50 | 0.40 | 0.20 | 0.25 | 0.05 | 0.20 | 3.5 cm. Rolling 3 cm. Of Ship 3 cm. At top 3 cm. Of Masts 3 cm. Pitching: None. |
| | | | B | 0.90 | 0.20 | | 0.20 | 0.15 | 0.05 | 0.10 | 0.01 | 0.05 | |
| | | | C | 0.90 | 0.20 | | 0.10 | 0.15 | 0.15 | 0.15 | 0.05 | 0.05 | |
| | | | D | 0.90 | 0.15 | | 0.40 | 0.15 | 0.05 | 0.10 | 0.03 | 0.06 | |
| | | | E | 0.90 | 0.15 | | 0.25 | 0.10 | 0.05 | 0.10 | 0.00 | 0.01 | |
| | | | E1 | 0.90 | 0.50 | | | | | | | | |
| | | | E2 | 0.90 | 0.50 | | | | | | | | |
| | | | E3 | 0.90 | 0.60 | | | | | | | | |
| | | | E1+E2 | 0.90 | 0.30 | | | | | | | | |
| | | | E2+E3 | 0.90 | 0.25 | | | | | | | | |
| | | | E1+E3 | 0.90 | 0.35 | | | | | | | | |
| Waves from East | 7.50 to 8.00 | Height 3m.50 Wave Length 50m. Period 7sec. | D | 1.20 | 0.25 | | 0.25 | 0.15 | 0.35 | 0.50 | 0.15 | 0.15 | |
| | | | E | 1.20 | 0.30 | | 0.30 | 0.20 | 0.35 | 0.60 | 0.20 | 0.20 | |
| | 8.00 | Height 2m. Wave Length 30m. Period 6sec. | A | 0.90 | 0.50 | | 0.35 | 0.35 | 0.06 | 0.25 | 0.08 | 0.05 | |
| | | | E | 0.90 | 0.20 | | 0.25 | 0.20 | 0.02 | 0.15 | 0.03 | 0.05 | |

Reference

A. Existing Wall. B. Single Wave-trap. C. 3 Wave-traps rectangular.
D. 3 Wave-traps trapezoidal. E. 3 Wave-traps triangular. E1 North triangular wave-trap.
E2 Central triangular wave-trap. E3 South triangular wave-trap.

The changes of level are given in dimensions representing centimetres in the model or metres in the actual harbour.

### IV.—Results of Experiments

From inspection of the tabular summary the following conclusions may be drawn:—

1. With the swell arising from an ordinary storm, the fluctuations of water level as measured against the present east wall in the model (Series A of experiments) are practically proportionate to the fluctuations observed in the real harbour at points corresponding. Thus the model faithfully reproduces the propagation and subsidence of the wave motion, to the reduced scale.

2. The single wave-breaker is the least effective form. The three trapezoidal breakers are the most effective when the swell is from the east. The three triangular breakers are the most effective when the swell is from the north-west, as is the most frequent and most dangerous case. It is therefore this form that should be provided. They are all three effective: none of them can be dispensed with. They have no appreciable effect on the movements of the model ship.

3. With a swell coming from the north-west, the three triangular wave-traps effect reduction in the following proportions:—

| | North Channel | Outer Harbour | Fish Dock | South Channel | Inner Harbour |
|---|---|---|---|---|---|
| Storm ... | 2/1 | 2/1 | 2/1 | 3/1 | 4/1 |
| Rough Sea | 5/1 | 3/1 | 4/1 | 3/1 | 25/1 |

It may therefore be reckoned that, at high tide, the entering wave-swell is reduced, in the harbour as a whole, by at least one-half. At low tide, of course, the wave-traps are inoperative; but then the wave action enters shallow water only and dies down as it advances into the basins; the disturbance occasions no trouble to shipping.

## *Publications*

"Scrap Book of London River," by A. G. Thompson, with a foreword by Revd. P. B. Clayton, C.A.M.C. (Founder of Toc H.), contains in its 15 chapters many interesting details of the history of the River Thames from early times to the present day. One chapter worthy of special mention, describes the evolution of London's Docks from the first small dock constructed at Blackwall in the year 1661, to the world's largest Dock System, now under the control of the Port of London Authority. The book is illustrated with original sketches by Miss Helen McKie and is published (price 1s.) by Messrs. Bradley and Son, Ltd., of Fleet Street, London.

H.M. Stationery Office have just issued at 1/3 net (postage extra) a Census of Seamen as at June 15th, 1936, for vessels registered in the United Kingdom. It contains tables and particulars relating to the numbers, ages, ratings and nationalities of seamen employed; the numbers serving on deck, in the engine room, etc., the number serving on ships in different tonnage groups, and the number serving on passenger ships, together with other information.

Myhre's Handbook of Baltic and White Sea Loading Ports. Seventh revised and extended edition. J. Jorgensen and Co., Copenhagen. Stobart and Son, Paternoster Row, London. 1,006 pages. Price 30s.

The seventh issue of this useful publication, inaugurated by the late Mr. J. F. Myhre, will be found fully as serviceable as its predecessors. The volume is designed as a handbook specially applicable to the timber trade in the Baltic and the British Isles. It contains a great deal of valuable information, evidently collected with much care, on port charges and customs, stevedoring rates and harbour facilities, the changes in which during the past two years have necessitated a thorough revision of the previous text. The opportunity has been taken to incorporate a number of additional timber ports on the North Coast of Germany, in Holland, Belgium, Great Britain and Ireland. Altogether, the volume will be found extremely serviceable as a reference work by all who are in any way associated with the shipment and discharge of timber cargoes.

We have received an attractive brochure illustrating various types of machinery manufactured by Messrs. John M. Henderson and Co., Ltd., of Aberdeen. The comprehensive list includes, among other items, Cranes, Aerial Cableways, Transporters, Hoist Conveyors and Mechanical Handling Appliances.

# *Notes of the Month*

**American Association of Port Authorities.**

The Annual Convention of the American Association of Port Authorities will be held at Wilmington, Delaware, from the 11th to the 15th October.

**Falmouth Harbour Powers.**

Under the Pier and Harbour Order (Falmouth) Confirmation Act, 1937, recently passed, the Falmouth Harbour Commissioners are empowered to acquire additional lands by agreement and to retain, use, sell or otherwise dispose of any properties vested in them. The number of Commissioners is reduced from 16 to 12. Powers are given to levy rates, including rates on seaplanes using the harbour, and provision is made for periodical revision of rates. Further clauses in the Act deal with the removal of sunk, stranded or abandoned vessels.

**Map of Port of London Docks.**

The Port of London Authority have just produced a map of their dock systems (approximate scale, 4½-in. to a mile), designed to be of maximum assistance to shipowners' and merchants' staffs, transport proprietors and all those whose business is in any way connected with the docks. The map is printed in four colours and all the road entrances to the various docks, the offices, the numbers and names of the dock warehouses and sheds, the dock road and rail systems, etc., are shown. Copies may obtained, price 6d. from the Public Relations Officer of the Port of London Authority.

**Dredging in St. Lawrence Ship Canal.**

A contract amounting to £2,300,000 sterling, has been awarded to General Dredging Contractors, of Montreal, by the Canadian Government, for the completion of the dredging of the St. Lawrence Ship Canal.

Since 1934 alarm has been felt because at certain periods the water level in Montreal Harbour has fallen considerably. Experts were appointed to study the causes for this, and the Government, following their recommendations, have now decided upon a programme which is expected to solve the problem. The Government's own dredging equipment, which has been doing the work for a number of years, has been sold in its entirety to the contractors for £340,000 sterling.

**Port Association Formed in California.**

The formation of The California Association of Port Authorities was announced early in July, by Mr. A. H. Abel, Port Manager of Oakland.

The purpose of the organisation is to study and discuss mutual problems and policies of port and terminal operation in the State of California. Membership in the Association is open to all public port authorities and to private marine terminal operators.

Temporary officers of the Association are G. E. Arbogast, vice-president of the Port of Los Angeles, chairman; and M. C. McCarl, traffic manager of the Port of Oakland, secretary.

**Unusual Shipments at Southampton Docks.**

Two export consignments of an unusual character were dealt with at Southampton Docks recently by the Southern Railway's 150-ton floating crane. One of the consignments consisted of three large electrical transformers, which were lifted on to the Baltimore Mail Line's "City of Baltimore" for despatch to the U.S.A. The other comprised a pair of armoured patrol vessels, each weighing 60 tons, ordered by the Iraq Government for service on the Rivers Tigris and Euphrates. These vessels, together with smaller craft, were shipped by the Strick Line's "Armanistan."

**Bombay Port Trust.**

At a meeting of the Trustees of the Port of Bombay held recently, the following estimates of expenditure were sanctioned:

Rs. 27,648 for widening the road at the Ferry Steamer Wharf, Alexandra Dock, from 30-ft. to 45-ft. 6-in., and other improvements with a view to easing traffic congestion at the wharf.

Rs. 19,300 for special repairs to the two caissons in Hughes Dry Dock.

Rs. 6,811 for extending the fuel oil pipe line from "K" berth to "L" berth on the Harbour Wall, Prince's Dock, to facilitate bunkering of oil-burning vessels using the Harbour Wall.

The Board accepted the provisional offer of the Karachi Port Trust of Rs. 8 lakhs for the purchase of the bucket ladder dredger "Barbus" and two 800-ton steam hopper barges, "Redshank" and "Bustard," these vessels being surplus to present requirements. It was further agreed that Rs. 72,944 should be spent on reconditioning the dipper dredger "Walrus."

**Port of La Guaira.**

Early last June, payment in full was made by Venezuela to the British Corporation of the Port of La Guaira, for the interest of the Corporation in that port. The transaction involved £1,500,000, paid by the Venezuelan Government in cash, and the nation has now acquired full ownership of the port.

**Quay for Inflammables at Buenos Aires.**

As part of a large scheme of harbour improvements, for which a sum of £1,500,000 was allocated in the public works plan for 1937, the Navigation and Ports Department has decided to construct a special quay in Buenos Aires harbour for the loading and discharge of inflammable cargoes.

**Panama Canal Enlargement.**

It is reported from Washington that plans are being formulated for enlarging the Panama Canal in order to provide for expected increases in traffic during the coming years. The undertaking would cost about 150 million dollars and would not be completed until 1960, work on the plans alone taking about 10 years. The canal was used in 1936 by 5,832 ocean-going vessels paying dues amounting to about $23,510,500 as compared with 5,732 vessels paying $23,330,000 during the previous year.

**New Graving Dock at Callao.**

The Peruvian Government have placed a contract with a New York firm for the construction of a new graving dock at Callao. It is to be 640-ft. long, 70-ft. internal width and will have a depth of water of 25-ft. 3-in. over the entrance sill at mean high water. The structure will be of reinforced concrete with a pumping installation electrically operated and of sufficient capacity to empty the entire dock in 2 hours 40 mins. At the present time, there are no dry docking facilities between the Panama Canal and Talcahuano, Chile, suitable for vessels engaged on the West Coast service.

**New Port at Providence Bay.**

It is stated in a recent issue of "Za Industrializatsiyn" that a new port is to be built at Providence Bay, the first Polar port in the Soviet Far East. Vessels on through voyages from the West will unload at the new port to make it possible for them to return in one navigation season. Workers' dwelling-houses, schools, workshops, mechanised bakeries and an electric power station will be started this year. The necessary building materials are beginning to arrive in order that building operations may be developed on a wide scale next spring.

**Traffic at Southampton Docks.**

The half-yearly statistics just issued relating to cargo and passenger traffic at Southampton Docks during the period January-June 1937, indicate that satisfactory progress was made compared with the corresponding period of last year. Cargo tonnage, which has registered consistent expansion during the past few years, showed an increase of 11% both imports and exports contributing to the improvement. So far as passenger figures were concerned the returns were particularly favourable, an increase of nearly 27% being registered in the total movements during the six months. During the early part of 1937—a year which is almost certain to establish new records for the number of passengers using the docks—two factors influenced this class of traffic, the Coronation celebrations and the Naval Review.

**Developments at the Port of Massowa.**

The Port of Massowa, or Massawa, on the Coast of Eritrea in the Red Sea, acquired considerable importance during the Abyssinian War, being used as the chief harbour base for Italian operations. It is stated in a recent issue of "Great Britain and the East," that the port will be further developed as an agency for colonising the conquered territory.

According to the publication in question, in 1938 the Port of Massowa will have 550 metres of quays where steamers with a draft of from 6 to 9 metres can come alongside, as well as 175 metres of quays for sailing ships, barges and lighters. This work is being done at a cost of about 15 million lire, and will permit of a volume of marine traffic suitable for the requirements and purposes of colonial expansion, not only in Eritrea but also throughout the rest of the Italian Empire. The equipment of Massowa will be completed by other mechanical apparatus and by the necessary technical services; particular mention is made of new electric cranes capable of lifting two-and-a-half tons. A special station will provide the necessary electric power. When in full operation and efficiently equipped, the port will be able to satisfy not only local requirements, but also those throughout the whole of Italian East Africa, including its relations with adjoining territories and the opposite coast of Arabia.

# *Port of London Authority*

## *Excerpts from Twenty-eighth Annual Report*

### Trade of the Port.

The total net register tonnage of vessels that arrived and departed with cargoes and in ballast from and to foreign countries and British Possessions and coastwise during the years ended 31st December, 1919-1936, was as follows:—

| | Tons | | Tons |
|---|---|---|---|
| 1930 ... | 58,085,598 | 1934 ... | 58,947,642 |
| 1931 ... | 56,074,556 | 1935 ... | 59,762,150 |
| 1932 ... | 53,903,886 | 1936 ... | 62,151,310 |

The tonnage of imported and exported goods, foreign and coastwise, of the Port of London for the twelve months ended 31st March, 1937 and 1936, respectively, was as follows:—

| IMPORTS | 1937 Tons | 1936 Tons | Percentage Increase on 1936 |
|---|---|---|---|
| Foreign ... ... | 17,707,831 | 17,110,486 | 3·5 |
| Coastwise ... ... | 15,810,371 | 14,993,580 | 5·4 |
| Transhipments ... | 1,758,531 | 1,544,557 | 13·9 |
| | 35,276,733 | 33,648,623 | 4·8 |
| EXPORTS. | | | |
| Foreign ... ... | 3,487,223 | 3,377,930 | 3·2 |
| Coastwise ... ... | 2,319,191 | 2,317,715 | 1·4 |
| Transhipments ... | 1,758,531 | 1,544,557 | 13·9 |
| | 7,594,945 | 7,240,202 | 4·9 |
| Total ... | 42,871,678 | 40,888,825 | 4·8 |

The total net register tonnage of vessels (including deck cargo tonnage) which, not being within the exempted classes, was liable to river duties of tonnage, inwards or outwards, during the twelve months ended 31st March, 1937 and 1936, respectively, was as follows:—

| | | 1937 | | 1936 | | Percentage Increase or Decrease on 1936 |
|---|---|---|---|---|---|---|
| Foreign | Inwards | 22,252,439 | | 21,958,398 | | + 1·3 |
| | Outwards | 10,248,720 | | 10,607,285 | | − 3·4 |
| | | | 32,501,159 | | 32,565,683 | − 0·2 |
| Coastwise | Inwards | 8,777,613 | | 8,553,946 | | + 2·6 |
| | Outwards | 2,908,955 | | 2,875,088 | | + 1·2 |
| | | | 11,686,568 | | 11,429,034 | + 2·3 |
| | | | 44,187,727 | | 43,994,717 | + 0·4 |

Of the above tonnage of vessels that paid river duties of tonnage, 57.5 per cent. used the wet docks of the Authority, compared with 58.1 per cent. during the twelve months preceding, as follows:—

| | | 1937 | | 1936 | | Percentage Increase or Decrease on 1936 |
|---|---|---|---|---|---|---|
| Foreign | Inwards | 15,546,869 | | 15,327,395 | | + 1·4 |
| | Outwards | 7,901,871 | | 8,211,420 | | − 3·8 |
| | | | 23,448,740 | | 23,538,815 | − 0·4 |
| Coastwise | Inwards | 1,063,257 | | *1,115,330 | | − 4·7 |
| | Outwards | 897,699 | | 911,994 | | − 1·6 |
| | | | 1,960,956 | | 2,027,324 | − 3·3 |
| | | | 25,409,696 | | 25,566,139 | − 0·6 |

**Adjusted*

The shipping entering the dry docks of the Authority during the twelve months was 2,679,505 tons gross, compared with 3,104,195 tons in the previous year.

During the twelve months ended 31st March, 1937, the Authority landed or received 2,306,092 tons of import goods for warehousing or for immediate delivery, an increase of 142,853 tons, or 6.6 per cent. on the tonnage dealt with during the previous twelve months.

The stocks of goods at the end of March, 1937, in the warehouses directly controlled by the Authority amounted to 553,287 tons, as compared with 496,432 tons at the corresponding date in 1936, an increase of 56,855 tons.

The export traffic handled by the Authority on the dock quays during the twelve months amounted to 728,813 tons, being an increase of 50,818 tons on the previous year's figure of 677,995 tons.

### Finance.

The capital expenditure for the year ended 31st March, 1937, amounted to £339,116.

The amount standing to the credit of the Stock Redemption Funds at 31st March, 1937, was £413,303. The investments held on account of these funds stand in the books at a value of £123,971, leaving a balance of £289,332 for investment, or to be used in exercise of borrowing powers.

Supplementary to the statutory requirements in regard to Port Stock, Provisional Redemption Funds are in operation for the redemption of certain expenditure for which borrowing powers have not yet been exercised.

The Capital Redemption Account now stands at £4,399,479, representing an increase of £369,618 during the year.

The expenditure during the year on account of the General Fund for Maintenance and Renewals of Premises and Plant and for Dredging was £162,796 and after transferring £100,000 from Net Revenue Account, the balance standing to the credit of this fund at 31st March, 1937, was £127,798.

The General Reserve Fund amounts to £1,050,000, and is fully invested in Trustee Securities.

The Insurance Fund now bears the cost of all the Authority's insurance, whether the risk is carried by the Fund or otherwise.

| | £ |
|---|---|
| Amount at 31st March, 1936 ... ... ... ... | 568,804 |
| Added since—Income accumulated from Investments | 27,523 |
| | 596,327 |
| *Less*—Losses, Re-insurances, etc., during the year ... | 4,543 |
| Amount at 31st March, 1937... ... ... ... ... | £591,784 |

The investments held on account of the Fund stand in the books at a value of £601,068.

### Works and Improvements.

The Authority have adopted in principle a programme of works for the improvement and development of their undertaking to be carried out in six separate stages at a total estimated cost of approximately £12,000,000. The following works included in the first stage of the programme have been approved and those detailed in paragraphs (a), (b), (e) and (f) have been put in hand:—

(a) Royal Albert Dock—replacement of No. 35 Shed by a new shed with equipment as a discharging berth for vessels with bananas and other cargo.

(b) Royal Victoria Dock—construction of a new quay 3,255 feet in length on the North side, including demolition of existing jetties and the dredging of the mudfield site and completion of the quay wall on the South side of the dock.

(c) India and Millwall Docks—widening of quay of Millwall Inner Dock, deepening of dock and provision of a new two-storey shed on the East side.

(d) Surrey Commercial Docks, South Dock—reconstruction of No. 1 Warehouse which was destroyed by fire and erection of a new four-storey warehouse to replace No. 3 Warehouse, including road improvements.

(e) Surrey Commercial Docks, South Dock—widening of quay on the North side and adaptation of No. 2 Warehouse for the storage of plywood.

(f) Electrification of quays at the West India, Millwall, Surrey Commercial, Royal Albert and Tilbury Docks, and the provision of electric cranes and other mechanical appliances.

At the Lavender Dock and Surrey Commercial Docks, three new sheds for the storage of softwood with a barge canal between to facilitate the transfer of timber have been completed and brought into use.

On the South side of the West India Import Dock the erection of a two-storey shed for the accommodation of produce from the Canary Islands and the widening of the quay are in progress.

The deepening of the Connaught Road Cutting leading from the Royal Victoria Dock to the Royal Albert Dock and the construction of the new quay and three-storey shed on the South side of the dock have been completed.

Substantial progress has been made with the construction of the quay wall for the widening of the passage into the Pontoon Dock, Royal Victoria Dock.

The widening of the North quay of the Royal Albert Dock has been completed and the dock deepened to 34 feet in front of the quay. Sheds Nos. 7 and 19 on the North side of the dock have been provided with new floors.

Shed No. 11 at Tilbury Dock, which was destroyed by fire, has been rebuilt, and the floor of No. 33 Shed has been reconditioned.

In the River, two 1,200-ton wreck-raising lighters have been delivered, and the floating landing pier at Westminster has been extended.

### General.

An order for the erection of 25—3-ton electric cranes has been completed and 30 more cranes have been ordered, of which 13 have been delivered.

The more important works carried out for the maintenance of the undertaking include the reconditioning and repair of lock gates at the Surrey Commercial and the West India Docks.

During the year 1,297,571 cubic yards of material were dredged from the river in order to maintain and deepen the channels.

The quantity of mud removed from the docks was 1,505,483 cubic yards.

The Report was signed by Lord Ritchie of Dundee (Chairman), and Mr. J. D. Ritchie (Secretary).

# *Coronation Visit to the Port of Belfast*

## *Their Majesties the King and Queen in Northern Ireland*

The State visit of Their Majesties King George VI. and Queen Elizabeth to Northern Ireland, as part of the Coronation Celebrations, took place on Wednesday, the 28th July, and included notable passages through the port and city of Belfast. The event had been eagerly anticipated by the inhabitants of the great Ulster metropolis and evoked widespread demonstrations of loyalty and affectionate greeting.

*King George VI and Queen Elizabeth disembarking from H.M.S. "Exmouth."*

The commencement of the tour was signalised by the entrance of the Royal party into Belfast Harbour, which was profusely decorated for the occasion. Upon the arrival of the Royal Yacht "Victoria and Albert," escorted by a flotilla of men-of-war and by aircraft of the Royal Air Force, a salute of 21 guns was fired. The yacht berthed at the east side of Thompson Wharf, where it was awaited by the Governor of Northern Ireland and the Duchess of Abercorn. The Thompson Wharf was gay with decorations, and every ship in the harbour displayed flags and bunting, making a colourful scene.

Subsequently embarking in H.M.S. "Exmouth" (Destroyer Flotilla Leader) at the west side of Thompson Wharf, Their Majesties proceeded to Donegall Quay, the progress of the vessel being watched by thousands of spectators on both sides of the Channel. Upon arrival, the Royal Standard was broken on the quay and another royal salute of 21 guns was fired. The party then disembarked at the Glasgow shed, where a remarkably decorative transformation in appearance had been effected. Here they were received by the Chairman of the Harbour Commissioners (Sir Ernest Herdman, D.L.), who was presented to Their Majesties by His Grace the Governor, after which the members of the Board, with the General Manager and Secretary (Mr. M. J. Watkins), and other officers were presented by the Chairman.

About 400 members of the public and a similar number of school children were accommodated on stands provided by the Commissioners in the shed, and were thereby afforded an opportunity of witnessing the ceremony. The shed, having been the scene of previous receptions, is now becoming famous in local annals as a Royal landing place.

On departing in the evening, Their Majesties passed through the Harbour Estate by way of Dee Street Bridge and proceeded along Hamilton Road. They visited H.M.S. "Carolina," headquarters of the Ulster Division R.N.V.R., *en route*, and when the King came over the side of the ship, he was piped aboard in the traditional manner. The inspection over, the Royal party then slowly travelled along Queen's Road to Thompson Wharf, their passage being delayed by the cheering crowds,

The King and Queen finally took leave of the Governor and the Duchess of Abercorn, His Majesty's Lieutenant of Belfast, the Cabinet of Northern Ireland, the Lord Mayor and Lady Mayoress of Belfast and the Chairman of the Belfast Harbour Commissioners and departed in the Royal Yacht, again escorted by men-of-war. And so ended a memorable visit, the incidents of which will long be recorded in the history of the Port of Belfast.

Prior to their sea journey to Belfast the Royal party were conveyed in the Belfast Harbour Commissioners' Tender, "Duchess of Abercorn," from the pier at Stranraer to the Royal Yacht "Victoria and Albert," which was anchored in Loch Ryan, and on their return the same procedure was followed in the reverse direction.

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### Pier Re-construction at Port Melbourne.

A proposal has been laid by the Chairman before the Melbourne Harbour Trust Commissioners for the re-construction of Prince's Pier, Port Melbourne, which within recent years has been little used except to relieve heavy pressure on the wharf accommodation at Station Pier, Port Melbourne, and at Victoria Dock. The pier is 2,000-ft. in length by 186-ft. wide, and it affords accommodation for four large overseas vessels, having a depth of 37-ft. of water alongside. It was built between 1912 and 1914, at a cost of more than £300,000.

Owing to increased demands for berthage accommodation at the port, it is felt desirable to extend and develop the pier, increasing its width and equipping it with modern cargo handling appliances, including electric cranes of a type similar to those at Station Pier and Victoria Dock. The existing buildings used for the disembarkation of passengers would be replaced by other structures.

The new pier, if constructed, would facilitate the discharge of vessels by enabling them to unload at that point instead of proceeding up the Yarra River. The work is estimated to cost about £100,000. No decision has yet been arrived at.

# *Facilities for Coastal Trade at Ports in England, Wales and Scotland*

## *Fifth Section of the Report by Messrs. WILTON & BELL, MM.Inst.C.E.*

*(continued from page 297)*

### Transit Sheds and Warehouses

(78) Opinions expressed to us on the merits of different types of transit shed were varied. There appears to be a concensus of opinion that there are very definite advantages in goods being allowed to be warehoused, if desired, instead of cleared within a certain number of hours or days. One obvious advantage is that extra handling is avoided. Where there is a double-storey shed, the use of the upper floor for warehousing purposes appears a convenient arrangement.

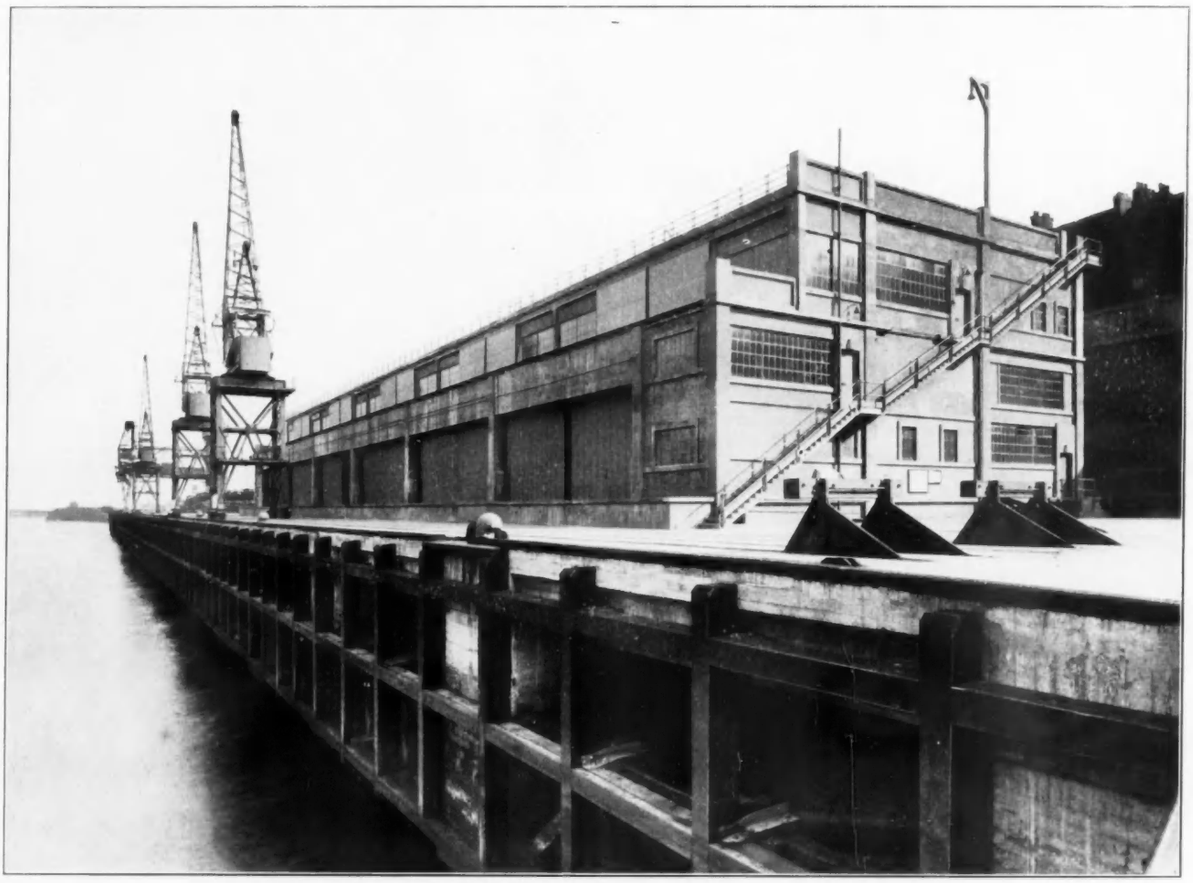
(79) Divergent opinions were expressed by those responsible for handling cargo as to whether motors and horse-drawn vehicles should be allowed inside transit sheds, and as to whether railway wagons should enter the sheds.

It is frequently an advantage for vehicles to come into a transit shed so that movement of cargo inside the shed is minimised when loading and unloading to and from vehicles. In one instance, where a shed was close to the quay edge, we noted vehicles brought inside the shed and right up to the quay so that cargo could be handled by ships' gear direct to and from the vehicles. Similarly, at one of the largest ports, we were informed that considerable economies were obtained by bringing vehicles to such a position on the quay that cargo was unloaded direct from ship to vehicle.

(80) One arrangement facilitated by the fall of the road which was convenient, was where vehicles could enter the transit shed at the ends, whilst the level of the road at the back was such that the level of the floor of the shed was there level with the platform of vehicles.

(81) A very unusual arrangement but one which has definite advantages, is that of the new transit shed at Sunderland. This shed has two storeys and also a flat roof. It abuts on a steep slope and, owing to the configuration of the ground, there is access for road vehicles at roof level as well as to the ground floor.

(82) Unless a transit shed is of very ample area, it appears that vehicles should not come inside the shed in the normal course of working, as the space left for them robs the shed of a good deal of its accommodation. Apart from this, road vehicles moving in a shed tend to hamper the movement of cargo trucks in it, and so to slow down the speed of working cargo. Where horse-drawn vehicles are used, apart from the consequent fouling of the floor surfaces, there is a conflict of interests, as the horses require a surface giving good foothold, whilst for ease in trucking, the surface should be as smooth as possible.



*Transit Shed at the Corporation Quay, Sunderland.*

(83) If vehicles do not come into a transit shed, the importance of having covered loading berths for vehicles is, we think, generally recognised.

An arrangement by which the upper floor of a two-storey shed is carried out beyond the lower floor to give covered loading berths for vehicles, is found to be a convenient arrangement.

At the Port of Bristol, we were informed by one firm dealing with a big coastal trade, that a covered space on the quay side was found very useful for storing goods under shelter which could not be placed in the transit for fear of their contaminating general cargo. A covered space on the quay side must, however, involve extra trucking of any cargo which has to go into the shed, and so for general cargo it appears desirable not to have this covered space at the front of the shed, but to bring the latter up to the quay front.

(84) Any arrangement for providing cover at the front of a quay over a coaster working at the quay is most unusual. It would, however, have great advantages in working cargo of a perishable nature in wet weather. The construction of such a shelter involves a high building or other structure from which to cantilever it out, and it must be at a great height to clear a coaster's masts and derricks. There is an instance of one at

## *Facilities for Coastal Trade at British Ports—continued*

Northwich, on the Weaver Navigation, at a wharf where specialised cargoes are handled to coasters.

(85) At many ports, we found that single-storey sheds used by the coasting trade were unnecessarily lofty. With coasting trade mechanical stacking of goods is not considered generally applicable, and with hand-stacking a height of more than 10-ft. or 11-ft. clear inside a shed does not appear necessary; in fact, above this, the space is normally waste. There are extreme examples where sheds used by the coastal trade are so lofty that they would admit of conversion into double-storey sheds by the construction of second floor of about half their height. This, of course, is on the assumption that vehicles would not enter the shed. Even where vehicles enter the sheds, some sheds have a height sufficient to allow of a second floor above the top of the loading gauge of highways, which, of course, governs the height of vehicle loads.

Very lofty eaves, where a shed is on the edge of the quay, would allow a ship's derrick to swing under them into the shed which does facilitate working cargo. A second floor in any but a very narrow shed would involve pillars inside the shed for its support, which hamper the movement of vehicles, but where storage is in demand and the area of ground is restricted, conversion to double-storey sheds deserves consideration.

(86) We also noted that at many ports the sheds used by the coastal trade were of a solid and somewhat expensive type, at others cheap types of shed were in evidence. There are types of the latter of recent construction which appear quite satisfactory. We noted several of steel construction, covered with corrugated steel which, we were informed, proved satisfactory, and they appeared to fulfil all the requirements of giving proper protection to the goods stored in them. At one port, nearly all the sheds were steel framed, covered with corrugated steel: some of these were twenty-five years old, but still in quite good condition. At another port, one of these steel-framed sheds was being constructed as a single-storey shed, but had the steel framing designed so that it could have a second floor added in the future if necessary. This type of steel-framed shed will have a lengthy life if it is given reasonable care, as is proved by examples which we saw of corrugated steel-sheeted sheds which had been in use for many years. The use of cement sheeting instead of steel as a covering for this type of steel-framed sheds which has been tried in some places, did not appear to us entirely satisfactory, owing to its being more readily damaged either by accident or deliberately.

(87) At a number of the smaller ports, where storage or transit sheds for cargo are either lacking or quite inadequate, a light steel-framed shed with corrugated steel covering would form an inexpensive but very valuable improvement. The value of such sheds to the coasting trade would be still greater if goods for local distribution were allowed to remain stored in them free, or at any rate at reasonable rates until required, that is if the sheds were used as warehouses as well as transit sheds.

(88) Shed floor surfaces and quay surfaces are an important item in working cargo. Even at some of the larger ports, we found the floor surfaces of some of the sheds in poor condition, offering great handicaps to rapid working of cargo inside the sheds. At many wharves the surfaces between the fronts of sheds and the quays were such that trucking across them would be almost impossible. Where the surfaces are very bad temporary runways are put down to allow of trucking, but this does not appear a very satisfactory arrangement.

(89) At several big ports there are shed floors over which trucking takes place, which are formed of stone sett paving, some of it uneven or uneven stone slabs, or uneven wood blocks. At some sheds, where the surface had been rough, a carpeting of bituminous material had been laid over the rough surface, and this, on the whole, appeared to be a satisfactory method of overcoming the trouble. There were, however, instances where this coating had not been sufficiently hard to stand up to heavy cargo piled on it and had become uneven. Evenly-finished concrete or very hard bituminous covering on a concrete foundation, appears to have the greatest advantages, and we saw many excellent examples of these at both large and small ports.

(90) We found instances of sheds allocated to coastal trade where the surface of the quay sloped down into the shed, and part of the shed floor continued at this slope. The result of this is that water runs down into the shed, making the front part of such a shed unsuitable for damageable cargo. If it is necessary to use these sheds for general coastal trade, this defect should be remedied by raising the shed floor.

(91) Opinions as to the widths of sheds for the coastal trade differ within limits, but a very wide shed appears to be regarded generally with disfavour, on account of the long distance which goods have to be trucked, if all the shed is to be utilised for cargo.

For general cargo a narrower double-storey shed would, we think, be found preferable to a wider single-storey shed, provided there were adequate cranes or other appliances to work cargo to the upper floor.

(92) Restrictions as to the time during which coastwise cargo was allowed to remain in transit sheds without extra charge varied. At one of the very largest ports a month was allowed without extra charge. At a smaller port, goods apparently remained even longer, if there was no other demand for the space occupied. Obviously, the right to keep cargo in the sheds for a considerable time and so avoid moving it to a warehouse, is of considerable advantage.

(93) To add to the facilities for coastal trade, we consider that as regards shed accommodation, attention might be given to the following points:—

(a) Where transit sheds allocated to the coasting trade are very lofty, and more storage space is advisable, the possibility of putting in a floor and so converting to double-storey sheds might be investigated.

*General Purpose Cargo-handling Crane at King's Lynn.*

(b) Where the ground between a shed and the edge of the quay is rough, and so is unsuitable for trucking, this should, if possible, be concreted to give a good even surface. At the very least, sufficiently wide strips of it should be concreted to form truckways into the shed.

(c) Any shed floors over which trucking takes place, if uneven, should be brought to an even surface either by covering with a bituminous coating or, preferably, by relaying in concrete with a smooth finish.

(d) Where there is either no accommodation or insufficient accommodation for temporarily storing cargo requiring protection from weather, sheds of an inexpensive type should be put up on the quayside. A steel-framed shed covered with corrugated steel appears to be both cheap and efficient.

(e) Sufficient floor area should be provided to allow of goods being kept in the shed for a reasonable time pending delivery. Unless there is very ample area of ground floor available, a two-storey shed has advantages if goods are to be retained in the shed, as they can be stored in the upper floor, and so the ground floor can be kept clear for working fresh cargo.

### Road and Rail Connections

(94) Road and rail access to docks and quays is of importance in facilitating conveyance of cargo to and from coasters. Naturally, at some ports one or other of these alternative forms of transport is of less importance. At the coal-shipping ports, for instance, roads are often of practically no importance, and the rail access is the vital factor. Similarly, at ports or quays where cargoes of a mixed character are discharged from coaster for local distribution road access is all important.

(95) So far as rail access is concerned, there are some even of the large ports where rail accommodation at the wharves is very restricted, or where its improvement would add to the efficiency of working of the sheds. This is, in some places, due to restriction of space, which offers serious and almost insoluble difficulties. As an instance, at Newcastle-on-Tyne the public roadway, which runs alongside a range of excellent coasting trade sheds, limits the width available for railway lines, though providing good road access to the sheds. The result is that loading to road vehicles from the sheds and the working of railway wagons to and from these sheds to some extent interfere with each other.

Another example is at one of the quays at Swansea where, we were informed, the railway line at the back of the shed had to be used for working railway wagons through to other berths, and so its use as a standing line for loading from shed to wagon was greatly lessened.

## *Facilities for Coastal Trade at British Ports—continued*

(96) Restriction of access to and from the main railway system also merits attention. We referred to this handicap at the Port of Boston when dealing with coal loading, but it occurs at many other ports, and where it is possible to overcome this difficulty, and any considerable quantity of traffic is to be dealt with by rail, it is an important point in handling goods to and from the quays.

(97) So far as road access to quays is concerned, we found that at a number of ports the road surfaces were not equal to modern heavy vehicle loads, whilst at many of the railway ports there is practically no road access provided. Naturally, at a railway port the intention is to handle coastwise trade by railway for local transport, and in many instances this no doubt is a cheap method of working. A large amount of coal is so dealt with in the south and south-west ports.

There are, however, many wharves accessible to railway wagons to which at present road vehicles cannot gain access either owing to the type of surfacing or the lack of connection to a road, and where these wharves have practically fallen out of use. It would, in various instances, be of advantage if these could be acquired by a local authority or a body of traders, and re-modelled to allow road vehicles to come to them for working cargo from coasters. We noted several instances where obviously they could be adapted without any heavy outlay.

(98) The problem of making road and quay surfaces at some of the smaller ports suitable for modern vehicular roads is of importance, as there are considerable areas of these road and quay surfaces in a poor state. At some, we were informed that they would be dealt with, but the cost of remaking is heavy and, unless properly constructed, such road will soon fall into disrepair. If these roads and quays could be treated as if they were part of the public road system, and aid given for their reconstruction, it would ease a burden on the smaller ports which, without assistance, appears to be too great for them to carry.

### Oil Depots

(99) In the course of our inspection of the English, Welsh and Scottish ports, we saw over forty oil depots ranging from the largest depots to very small tanks at minor ports.

A number of the smaller installations could be improved, so far as the berthage is concerned, at small cost. Viewing the matter from the point of view of increasing the transport of oil and spirit by coasting tankers, consideration might be given to the installation of depots at a number of other places.

(100) The possibility of making improvement at Grimsby with a view to fostering carriage by sea to the oil depot there deserves investigation, and also improvement at Boston at the tabled berth, which connects to a small oil depot. Wisbech, which serves a large area, is also a coasting port which might take in oil and spirit by sea. Yarmouth also offers possibilities. Maldon will only take vessels of very shallow draught which offsets the advantages of its situation with reference to Chelmsford and that part of Essex. At Rochester there might be developments in coastwise import of oil and spirit.

(101) Provision for dealing with oil and spirit by coaster for the area including Ramsgate and Margate, might be met by a depot at either of these harbours, except for the fact that they are each so close to a large residential part of these towns that there would be difficulties in finding any suitable site. Sandwich, which already has a small depot, is within easy reach, and development there, or at the adjacent port of Richborough, would probably be preferable.

(102) In the area from Dover to Shoreham, oil and spirit are handled mainly by road and rail transport. Rye Harbour might serve as a distribution centre for oil and spirit to the large area intervening. Between Poole and Exeter, Weymouth might be developed as a depot for oil and spirit, and between Exeter and Plymouth the possibilities of development at Teignmouth merit consideration.

(103) There is a small depot at Falmouth, but a depot for distribution by road and rail from Par, which would serve a considerable area of Cornwall, appears to offer considerable advantages, as there is ample area available there. At Padstow the area quarried out in connection with the provision of stone for the new breakwater offers a convenient site for a small oil depot, which could readily be linked to one of the quays.

(104) If Ilfracombe Harbour were remodelled, it might be possible to establish a satisfactory oil depot behind the quays on the south side of the harbour to which coaster tankers could pump, and it would serve an extensive district. There might, however, be objections on the score of the proximity to residential parts of the town. If the Combwich Reach Scheme were developed at Bridgwater, it would offer a suitable position for a depot to serve the surrounding area.

(105) At Newport, at present, there is no provision for bringing in oil or spirit by coasting tankers. There is a small depot replenished by land transport, but it has a frontage where reasonable depths of water would be available, and it seems that a berth might be formed here or at some other suitable place to which coasting tankers might come from the large oil depots at Avonmouth on the opposite side of the Bristol Channel.

(106) In Wales, west of the big oil depot at Swansea, distribution appears to be wholly by land, but in view of possible developments in the vicinity of Milford Haven, the installation of an oil and spirit depot either at Milford Docks or at Neyland which could serve that area may be a future possibility.

(107) On the coast of Cardigan Bay from Fishguard northwards, oil and spirit do not come in for local distribution by sea, but suitable sites are available at both Cardigan and Aberystwyth which could be developed at no great cost, and would enable these places to serve a considerable area lying inland from them.

(108) In North Wales there is a depot at Caernarvon, but between there and the Mersey supply is by land transport. In view of the large population of the North Wales Coast, including such towns as Llandudno, Colwyn Bay and Rhyl, the possibility of a depot to which coasting tankers might come might be considered. Deganwy would be a suitable centre, so far as access from sea and distribution to land is concerned, but the wharf is owned by the London, Midland and Scottish Railway Company, and there is no road access to it, whilst the adjacent ground is a residential area. There does not appear, therefore, any possibility of a depot being made there. Conway, on the opposite shore, could only provide a site convenient to the wharf on a private estate which, we understand, would not be available for such a use.

(109) On the north-west coast of England, there are very large oil depots at Liverpool and Stanlow on the Manchester Ship Canal. From the latter, distribution up this Canal is carried out by smaller tankers, ocean tankers discharging at Stanlow Oil Dock. On the Upper Mersey there is a small depot at Warrington. Preston has a large oil depot, which serves a considerable area, and there is a smaller depot at Maryport. The depot which had existed at Barrow, a fairly large one, has now, we were informed, been given up.

(110) The possibility of installing one or two small oil depots in the south-west of Scotland between the Ardrossan Oil Depot and the Maryport Depot in Cumberland deserves investigation. We were informed that oil and spirits came to Stranraer by road or rail, and that this method of delivery sufficed for local needs. In the event of improvement of this harbour, the advisability of providing an oil depot, fed from the quay, and with fuelling points on the quay might be considered. Depots at Ardrossan and Glasgow serve the industrial area of the Clyde adequately.

Further north, on the west coast of Scotland, it seems doubtful if any development of oil depots could be justified by the demand for oil and spirit.

(111) On the east coast of Scotland the depots at Inverness, Aberdeen, Dundee, Grangemouth and Leith appear to provide adequately for that coast, and it is doubtful if the construction of small depots for coastal-borne oil at the numerous minor ports, which are mainly used by the fishing industry, would be financially successful. Apart from the possibilities referred to in § 110, it appears that the existing oil depots at Scottish ports can serve those districts where trade and population are centred, and that the demand elsewhere would be insufficient to make coastal tanker trade remunerative.

### Summary

(112) Before concluding this report, we desire to point out that we have not dealt with the multitudinous wharves of the great Port of London, nor have we dealt in detail with all the equipment, transit sheds and road and rail approaches of all the ports, as this would have made a somewhat lengthy report very much longer. We have, however, drawn attention to the salient facts calling for general attention at ports dealing with the coastal trade and given outstanding instances of difficulties. On the very complicated matter of access to the ports at various states of the tide, we have gone into considerable detail, as the broad lines of policy which should be adopted for coastal ports is closely inter-related with the types and sizes of vessels which will in the future carry on the coasting trade.

(113) As a summary of this report, we consider that we should draw attention to the following points:—

(a) The possibility of improvement of all ports of any moment used by the coastal trade to a standard at least equal to taking a 14-ft. draught vessel at spring tides and a 10-ft. draught vessel at neap tides, and for the more important coasting ports of taking 14-ft. draught on any tide.

(b) The importance of small draught for coasting vessels, especially for the tramp coaster, in view of the heavy cost to coasting ports of artificial deepening by dredging, especially where dredging would be a frequently recurrent item.

(c) Where berths are not tidal berths, the possible extension of times of access by the provision of lock entrances instead of entrances with only one pair of gates or, alternatively, of working some of the impounded docks as tidal docks.

## *Facilities for Coastal Trade at British Ports—continued*

(d) The provision of more detailed and reliable information as to depths of water available at various states of the tides at even minor coasting ports.

(e) The importance of efforts being made to prevent the restriction of navigation to ports up rivers or inland waterways by road crossings, either unnecessarily numerous or restrictive in headway, and to remove these restrictions where bridge or road reconstruction is taking place.

(f) The possibility of providing at many of the ports, transit sheds of an inexpensive type for general cargo, and the more general use of sheds adjacent to the quayside for warehousing purposes, in order to avoid extra handling of goods.

(g) The general improvement of the surfaces of the floors of many old transit sheds and working quays, either by resurfacing with concrete or by laying a hard bituminous surfacing over the existing uneven floors.

(h) The provision of more mechanical shore appliances to supplement ships' gear in working cargo and so increase speeds of working. This is especially desirable where access to berths is restricted by tidal conditions, in order that vessels may not be delayed, after loading is completed, through having missed the tide. In this connection, ability to move the shore appliances readily from one berth to another is a very distinct advantage in their economical use.

(i) The importance where physically practicable, of both road and rail access to coastal berths generally, in order that there may be alternative methods of local transport available. In certain specialised ports (c.f. coal-loading ports) both forms of transport are not necessary, but as a general rule they should be available. In some instances road access could easily be given where now there is none.

(j) The provision of more oil and spirit depots to serve local areas, with berths which could be reached by coastal tankers. A number of this type of depot exists, but there are many small ports which might have such installations carried out with advantage to coastal trade, and the berthage required is of a very inexpensive type.

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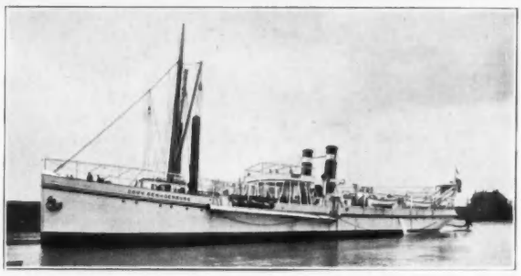

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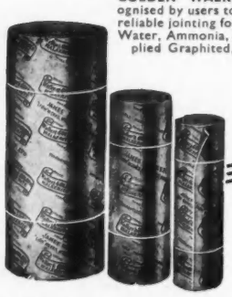

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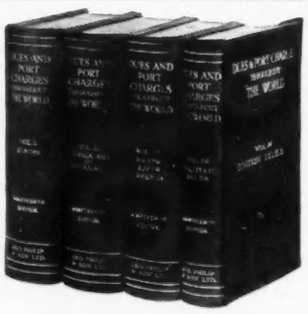

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